

THE SHARP-TAILED GROUSE IN UTAH

**ITS LIFE HISTORY, STATUS
AND MANAGEMENT**



Publication No. 3

of the

**UTAH STATE DEPARTMENT OF
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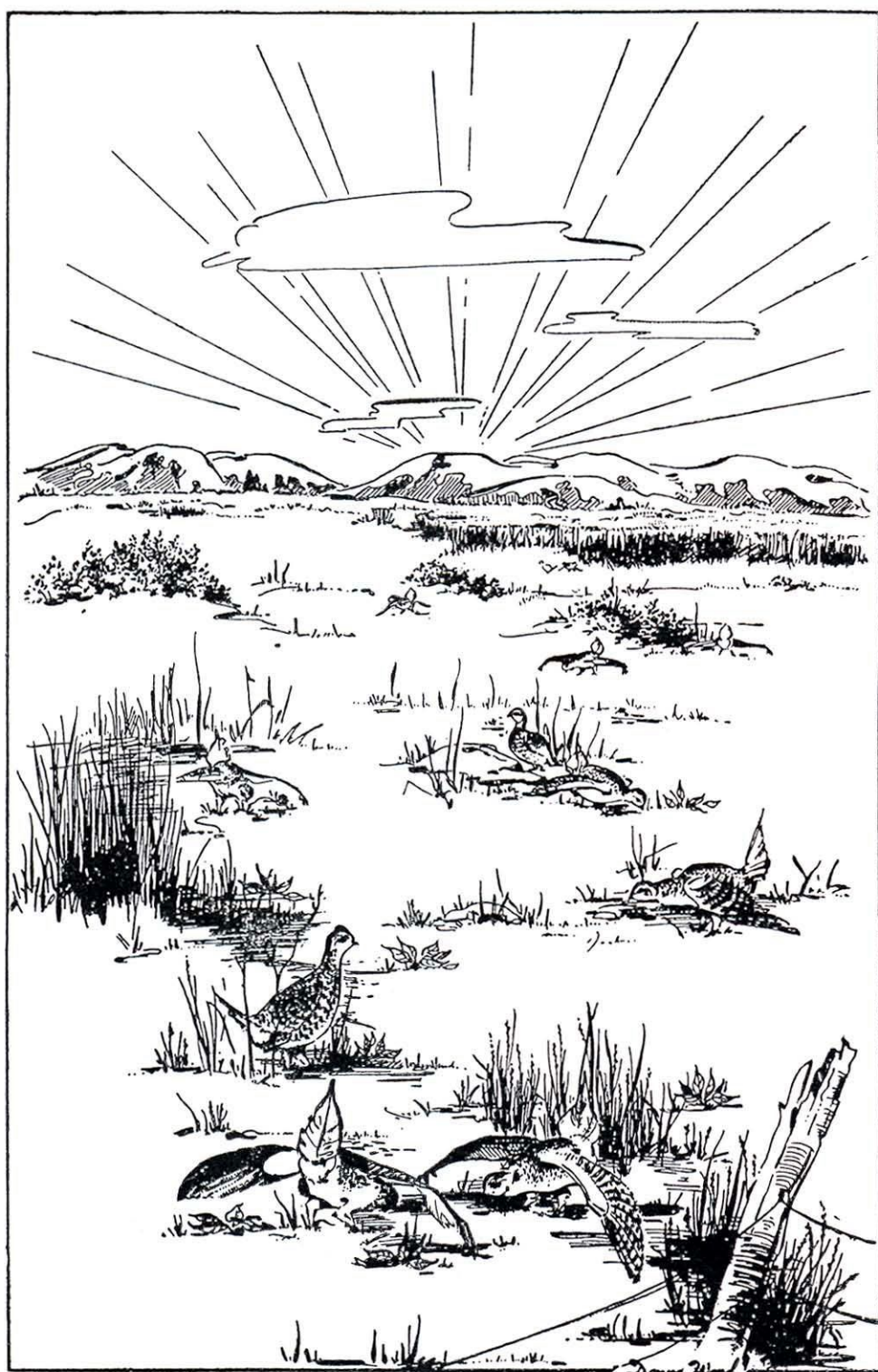
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THE SHARP-TAILED GROUSE IN UTAH

ITS LIFE HISTORY, STATUS, AND MANAGEMENT (1)

By

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ABSTRACT

The Columbian sharp-tailed grouse, found in the intermountain region of the west, is one of six races of sharp-tailed grouse originally distributed throughout most of North America. This grouse, once abundant in Utah, is now comparatively rare.

The sharp-tails were originally abundant where grassy plains, benches, and foothills were found in northern and central Utah, but are now restricted to a few areas in north central Utah. Population estimates made in 1936 and 1948 indicate that approximately 1,500 sharp-tails remain in Utah, with the greatest concentration in southern Cache Valley and northern Ogden Valley.

Changes in habitat undoubtedly have resulted in vastly different quantities of both food and cover plants so essential to the bird. Nests of the sharp-tails are also subjected to destruction from agricultural practices and probably less than 50 percent of the juvenile birds ever reach maturity.

Destruction of sharp-tail habitat by cultivation, improper grazing, and burning has undoubtedly been the principal factor causing the decrease in the sharp-tail population in Utah.

Protection of the bird from hunting, since 1925, has been the principal method followed to date in attempting to preserve the sharp-tail in Utah. It is recommended that at least one "perpetuation" refuge be established in the middle of the remaining sharp-tailed grouse habitat in Utah. The desirability is recognized for a system of state-owned refuges to be established where control of cultivation, livestock grazing, and burning can be coupled with planting of food and cover plants to improve the habitat so that the sharp-tailed grouse may find favorable conditions for their continued existence.

INTRODUCTION

The Columbian Sharp-Tailed Grouse (*tediocetes phasianellus columbianus*) is one of several species of grouse originally very abundant in Utah. It was an important game bird throughout its range for a long period of time after settlement of this area by white men, which began about 1850. Unfortunately, the story so often told of our native prairie grouse in North America is also true of the sharp-tail in Utah. Since the turn of the century these birds have decreased rapidly in number. This interesting and valuable game bird is now comparatively rare and possibly in danger of being extirpated here.

In recent years the plight of the sharp-tail has aroused the interest of individuals and organizations associated with wildlife research and management within the state. A study of these birds was one of the original projects of the Cooperative Wildlife Research Unit at Utah State Agricultural College in Logan. The location of this college near one of the last remaining concentrations of sharp-tails in Utah enabled students and faculty members of its Wildlife Management Department to gather considerable information about the grouse. Existing knowledge of sharp-tails and their management in Utah is far from complete, but it is hoped that publication of information obtained to date will stimulate interest in the preservation of this native game bird, serve as a basis for further studies, and be of value in planning practical management work.

Thus, the purpose of this paper is two fold: (1) to compile and make available the information that has been gathered about the life history, ecology, and management of the sharp-tailed grouse in Utah from 1935 to the present time, and (2) to point out possible management measures which it is believed may save the bird from extinction. The field work upon which this report is based has been completed largely during the period 1935 to 1948. Except for historical data the principle sources of information on this bird in Utah have been field notes, reports, and theses of students and faculty members of the Utah State Agricultural College, personnel of the Utah Cooperative Wildlife Research Unit, and the Utah State Department of Fish and Game.

CLASSIFICATION AND DESCRIPTION OF THE COLUMBIAN SHARP-TAILED GROUSE

The grouse family is represented in Utah by the dusky blue grouse (*Dendragapus o. obscurus*) and the gray ruffed grouse (*Bonasa umbellus umbelloides*) in wooded mountains, the sage hen (*Centrocercus urophasianus*) in sagebrush areas, and the Columbian sharp-tailed grouse (*Pediocetes phasianellus columbianus*) in grassy uplands.

Various sub-species of the sharp-tails were found at one time throughout much of Canada, Alaska, and western and mid-western United States. Snyder (1935b: 7) presented a suggested revision of the classification of sharp-tailed grouse which apparently is the latest complete taxonomic review of this genus. On the basis of his study Snyder recognized two general groups of sharp-tails including five races, and discussed the possibility of a sixth race. The Columbian sharp-tailed grouse is included in the group found in the Great Basin and far Northwest. The only other member of this group is the northwestern sharp-tailed grouse (*Pediocetes phasianellus kennicotti*) of the Alaska, Yukon, and Mackenzie region.

Distinguishing characteristics

The Columbian sharp-tailed grouse is the smallest race of the sharp-tails and is often referred to as a gray form. It can be differentiated easily from other native or introduced game birds on the basis of size, coloration, shape of tail, and manner of flight. Particularly characteristic are the wedge-shaped tail and rocking flight resulting from what appears at first glance to be alternating wing beats interspersed with periods of gliding.

The Columbian sharp-tailed grouse was first described by Captain Lewis of the Lewis and Clark Expedition, apparently in 1806. Hosmer (1905:190) quotes Lewis as follows:

The grouse or prairie-hen. This is peculiarly the inhabitant of the great plains of the Columbia, and does not differ from those of the upper portion of the Missouri. The tail is pointed, the feathers in the centre are much longer than those on the sides. This species differs essentially in the formation of the plumage from those of Illinois, which have their tails composed of feathers of an equal length. In the winter season the bird is booted to the first joint of the toes; the toes are curiously bordered on their lower edges with narrow hard scales, which are placed very close to each other, and extend horizontally

about one-eighth of an inch on each side of the toes, adding much to the broadness of the feet, a security which bounteous nature has furnished them for passing over the snows with more ease, and what is very remarkable, in the summer season these scales drop from the feet. This bird has four toes on each foot; the color is a mixture of dark brown, reddish and yellowish brown, with white confusedly mixed. In the assemblage of colors, the reddish brown prevails most on the upper parts of the body, wings, and tail, and the white underneath the belly and the lower parts of the breast and tail. These birds associate in large flocks in autumn and winter, and even in summer are seen in companies of five or six. They feed on grass, insects, leaves of various shrubs in the plains, and on the seeds of several species of speth and wild rye, which grow in richer soils. In winter their food consists of the buds of the willow and cottonwood and native berries.

From this description it is evident that the bird observed by Lewis on "the great plains of the Columbia" was the sharp-tailed grouse. The species in Illinois referred to was evidently the true prairie chicken or pinnated grouse (*Tympanuchus cupido americanus*). It is somewhat larger than the sharp-tail and is distinguished by the presence of elongated pinnae or neck tufts, as well as the evenly rounded tail mentioned above by Lewis.

Additional information on plumage and markings is furnished by Lee (1936:15) in his description of a captive adult female sharp-tail in winter plumage as follows:

A number of feathers about one inch long arise on the top of the head one-half inch back of base of bill, above the eye. These feathers can be erected at the will of the grouse through various angles up to 90 degrees and form the characteristic "topknot" effect. They are not plumes, however, and they lie perfectly smooth when at rest. Another small tuft of dark feathers conceal the ear directly behind the eye, these are not normally erectile. A narrow dark line of feathers extends back from the lower mandible and parallel to it extending below the eye to the tuft behind it, leaving a yellowish white strip around and in front of the eye. The throat is yellowish and blends into the irregularly brown and white markings of the neck. The dark "V" marks on a white background are distinct and regular on the breast and fade to mere specks

on the abdomen. Between and behind the legs white prevails and the upper tail coverts are all white. The feathers of the lower back and rump are beautifully colored with orange, yellow, and brown surrounding black irregular stars. The two middle tail feathers extend beyond the other tail feathers about two inches and combined are about three-fourths of an inch wide (this is the distinguishing character of the Sharp-tailed grouse). The wing coverts are irregularly spotted with white on a brownish background. On the under side of the wing, the inner half is white, while the outer half is a light chocolate.

The grouse is able to spread the feathers on the side of the neck, making a furrow two inches long and one-fourth inch wide, giving the neck a wide appearance as viewed from the front.

The erectile feathers of the neck do not appear to differ in structure from the regular neck feathers. The erection of the crown and neck feathers appeared to take place at will and this could happen simultaneously with or independent of each other.

The tail is wedge-shaped. It is lowered to a horizontal position when the grouse is feeding, and is raised to an angle of 90° when the grouse is in an alert attitude.



Weights and measurements

An opportunity to collect a representative sample of data on this subject has not existed in Utah in recent years. There has been no open season on these birds for 25 years, and no accurate records of measurements taken when there were open seasons have been found. Trapping of sharp-tails has not been done. Thus, records of this type are limited to a few obtained from carcasses picked up in the field. Deming (1938:30) found the weight of two male birds to be 756 and 721 grams or about 1 pound and 9 ounces to 1 pound 11 ounces (Table 1).

Snyder (1935a:53; 1935b:8,9) presents the only available measurements of a series of Columbian sharp-tails (Table 1). The area from which these specimens were collected is not known.

TABLE I. MEASUREMENTS OF COLUMBIAN SHARP-TAILED GROUSE.

Reference	Number of individuals		Wing		Tail		Exposed culmen		Depth of culmen at nostril	
			mm.	inches	mm.	inches	mm.	inches	mm.	inches
Snyder 1935a 1935b	19 males(1)	Max.	203.0	8.0	132.0	5.2	15.0	0.6	9.5	0.4
		Min.	191.0	7.5	118.0	4.6	13.0	0.5	8.5	0.3
		Ave.	197.2	7.8	122.7	4.8	14.3	0.6	9.0	0.4
	10 females(2)	Max.	202.0	8.0	128.0	5.0	14.5	0.6	9.0	0.4
		Min.	190.0	7.5	119.0	4.7	13.0	0.5	8.0	0.3
		Ave.	191.2	7.5	121.8	4.8	14.4	0.6	8.5	0.3
Deming 1938 (Utah)	2 males	Max.	205.0	8.1	116.5	4.7	15.0	0.6	9.3	0.4
		Min.	191.0	7.5	116.0	4.6	13.8	0.5	9.0	0.4
		Ave.	198.0	7.8	116.3	4.6	14.4	0.6	9.2	0.4
	1 female		197.5	7.8	116.0	4.6	13.6	0.5	9.1	0.4

(1) Maximum and minimum measurements available on only 8 individuals.

(2) Maximum and minimum measurements available on only 5 individuals (4 individuals on tail measurements).

Sex differentiation

External sex differences are so slight that it is rarely possible to identify positively one sex from the other in the field. For this reason there is no information on sex ratios of these birds in Utah, and knowledge of this subject is incomplete for other sharp-tail populations.

Male sharp-tails average larger in size than females and usually have longitudinal markings on the middle central and basal portion of the central tail feathers, where the females have transverse markings (Snyder, 1935b:2 and Figure 1). This method of distinguishing the sexes of sharp-tailed grouse by the rectrix pattern is of no value except with birds, or tail feathers, in the hand.

Manweiler (1939:283) found that the rectrix pattern alone was approximately 85 percent accurate for determining sex of sharp-tailed grouse in Minnesota and Wisconsin, which was corroborated by Snyder (*loc. cit.*) in Canada. The probability of distinguishing the sex of a sharp-tail by its weight alone varied from more than 90 percent in the high and low weight classes to approximately 50 percent in the median weight classes. Thus, sharp-tails having an intermediate type of rectrix pattern can be sexed with a high percentage of accuracy if their weight is near the extremes for the subspecies, but birds of near average weight remain doubtful as to sex (Manweiler, *loc. cit.*).

Common names

In Utah the Columbian sharp-tailed grouse is known by a variety of common names. "Prairie chicken" is the name generally applied to this bird by the native farmers and sportsmen. Other common names are "pin-tail" or "pin-tailed grouse", "sprig-tailed grouse", "prairie hen", and "wild chicken." Many people of Utah and surrounding regions loosely apply the term "chicken" to all native grouse and to the pheasant.

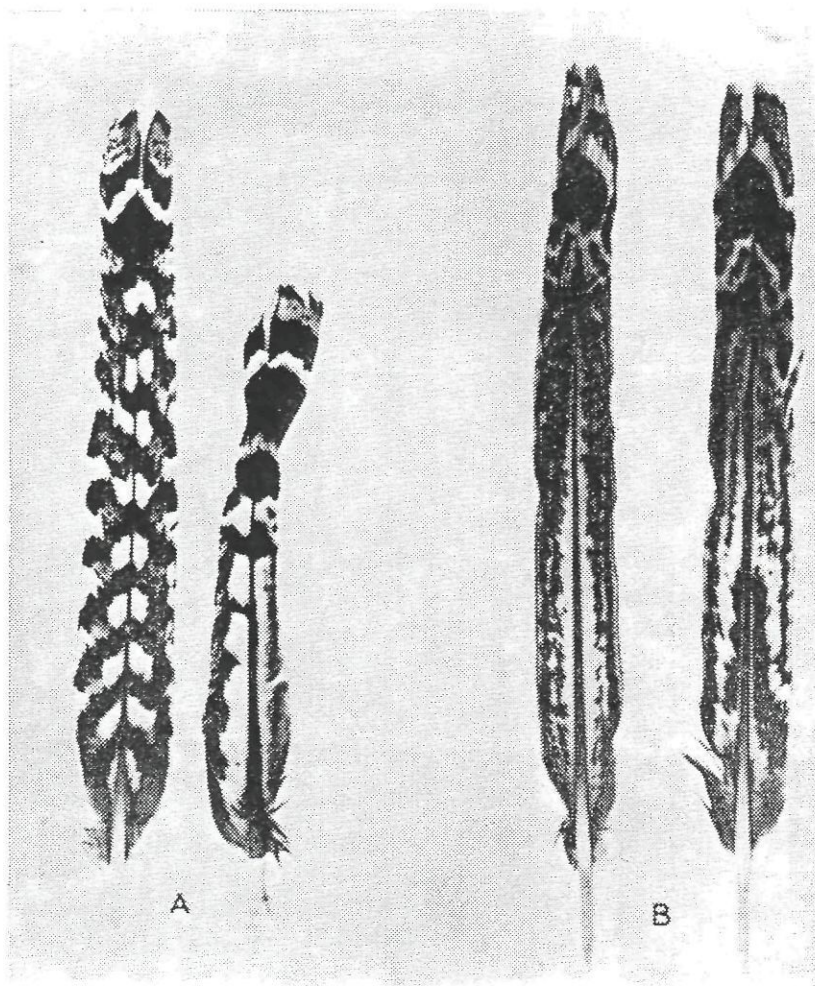


Figure 1. Typical tail feathers from sharp-tailed grouse showing differences in sexes. (a) Horizontal white markings typical of the female; (b) longitudinal white markings typical of the male.

RANGE AND ABUNDANCE OF COLUMBIAN SHARP-TAILED GROUSE

In North America

Former range and abundance.

The original range of the Columbian sharp-tailed grouse included the interior lowlands of British Columbia south to northeastern California, Utah, Colorado, and northern New Mexico (Figure 22). The sharp-tail generally occurred throughout this area where grassy plains, benches, and foothills were found, according to the accounts of early explorers and settlers. Bent (1932:28) quoted Major Bendire (1892) as saying the sharp-tail was found:

... inhabiting the prairie country to be found along the foothills of the numerous mountain chains intersecting its range; seldom venturing into the wooded portions for any distance; and then only during the winter.

Early records indicated that the sharp-tail was very abundant throughout its range in the Northwest and the Great Basin when this territory was first entered by the white man, and for many years thereafter. Major Bendire (Bent, loc. cit.) also stated, regarding the sharp-tailed grouse, that: "It is one of the most abundant and best known game birds in the Northwest."

Grinnell, Bryant, and Storer (1918:560) quoted Newberry (1857:94) regarding the early abundance of the sharp-tail in northeastern California as follows:

On this plain (Modoc County) were great numbers of birds of various kinds, and so many of the Sharp-tailed grouse, that, for two or three days, they afforded us fine sport and an abundance of excellent food.

Bailey (1918:145) stated that flocks of literally thousands of these grouse were seen near Glacier National Park, Montana, in 1912.

Present range and abundance.

Like many of our other native game birds and mammals, the habitat and numbers of the Columbian sharp-tailed grouse have been depleted until a mere remnant of the original population remains. In general these birds have disappeared from the outer limits of their original range, except in a few localized, favorable areas. They still exist in the more favorable areas near the center of the primitive range, but in greatly reduced numbers. Figure 2 illustrates the known distribution of the Columbian sharp-tailed grouse in 1936; the present distribution would probably vary but little from that of 1936.



Figure 2. Probable past range and present range of the Columbian sharp-tailed grouse in North America.

Lee (1936:21-24) attempted to determine the status of the Columbian sharp-tailed grouse in the western United States and Canada in the middle 1930's by sending questionnaires to the various game departments in the intermountain region. The response he received indicated about the same situation in general throughout the west; sharp-tailed grouse populations were at a low level; they were increasing somewhat in very few localities, but were generally slowly decreasing or barely maintaining their numbers.

In Utah

Former range and abundance.

The sharp-tailed grouse was apparently never widespread in Utah. The primitive range of this species in the state consisted of a rather narrow strip of territory extending from the vicinity of Junction in Piute County, on the south to the Idaho border on the north, and from there west across the northern part of Box Elder County to the Nevada border (Figure 3).

Early records indicate the widespread range in Utah of the sharp-tail. Carrington reported seeing two prairie hens on Antelope Island in 1848 (Tanner, 1940). Ridgway (1877) indicated it as a sparse bird of dry meadows and sagebrush in the Salt Lake Valley in 1869. Allen (1872) found the sharp-tail in Ogden Valley in 1871 and Nelson (1875) saw a few near Bountiful. Henshaw (1874) and Yarrow and Henshaw (1874) reported a single band near Meadow Creek, Millard County in 1872. Osgood (field report) reported a flock of about 7 a few miles below Panguitch Lake in Garfield County, in September, 1908.

The sharp-tail was originally very abundant where habitat conditions were favorable within its range in Utah. Lee(1936:25) quotes Joel Ricks, an early pioneer of Cache Valley as follows:

"In 1872-3, when the telegraph wire was put through Cache Valley, scores of Wild chickens (Sharp-tails) were killed by flying into it. There were tens of thousands of these chickens until about 1875 when they began to dwindle.

Dr. W. W. Henderson of the Utah State Agricultural College in Logan reported that in the 1890's it was not uncommon to see flocks of several hundred sharp-tails in northern Cache Valley. He believed it would have been possible to see ten thousand in one day by riding the range. The grouse were killed and wasted in enormous numbers. The breasts were taken from some birds, but

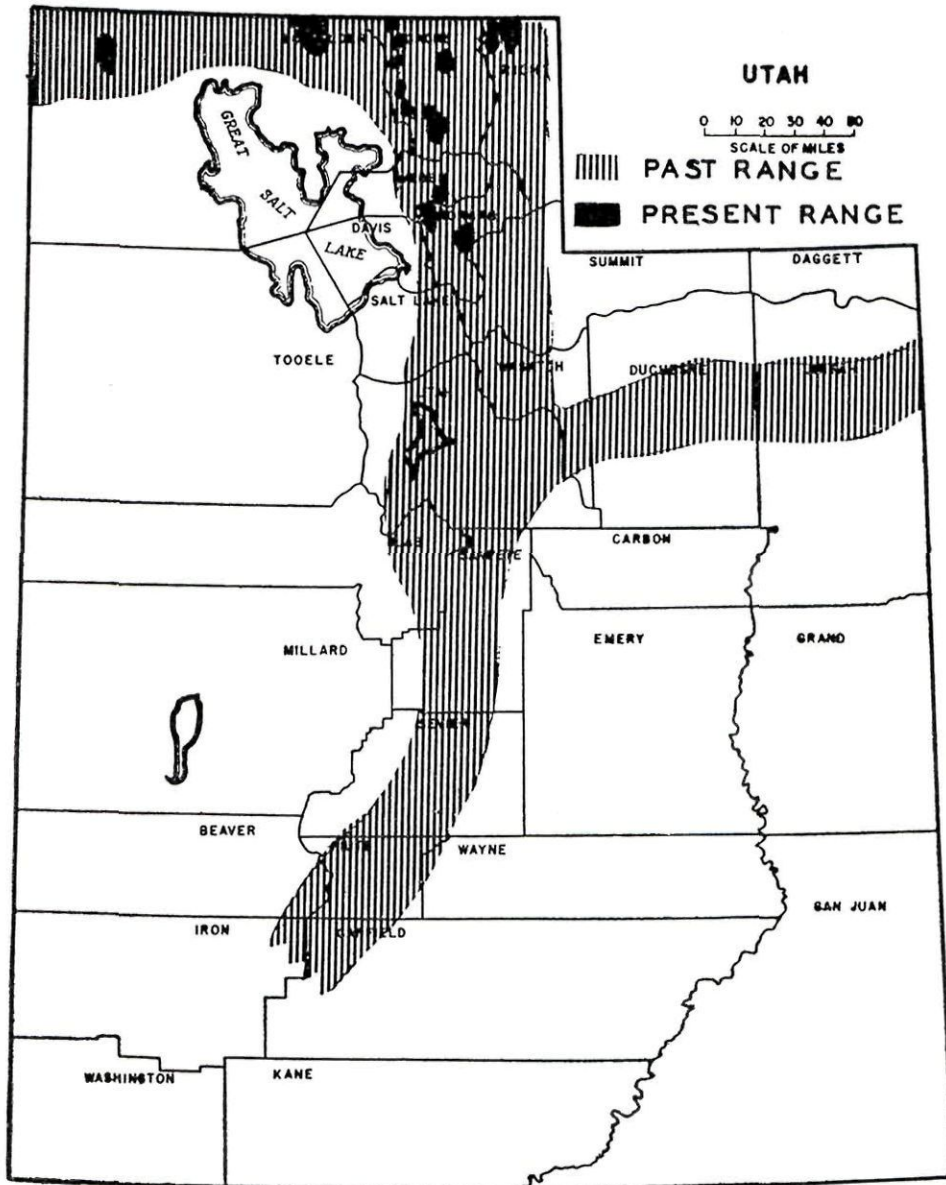


Figure 3. Probable past range and probable extent of present range of the sharp-tailed grouse in Utah.

the majority were not even gathered up.

The sharp-tails were reported to have been so numerous near Ogden that they "darkened the sun" when they flew. William Anderson of Weber County saw approximately 500 sharp-tails on a 3 or 4 acre alfalfa field northeast of Ogden in 1919. The grouse were said to be equally numerous in other counties, including; Morgan, Davis, Rich, Summitt, Salt Lake, Wasatch, Utah, eastern Juab, and Sanpete.

Present range and abundance.

In recent years the sharp-tailed grouse has survived in Utah in only a few areas located in the north central portion of the state (Figure 3). No sharp-tails have been reported in recent years from regions south of Morgan County and but very few regions west of the eastern part of Box Elder County.

In general, the areas still inhabited by the sharp-tails are those which have vegetation made up of a mixture of native grasses, forbs, and shrubs. Such areas occur within cultivated, dry-farm land as islands too steep or too rocky to cultivate, or as foothill

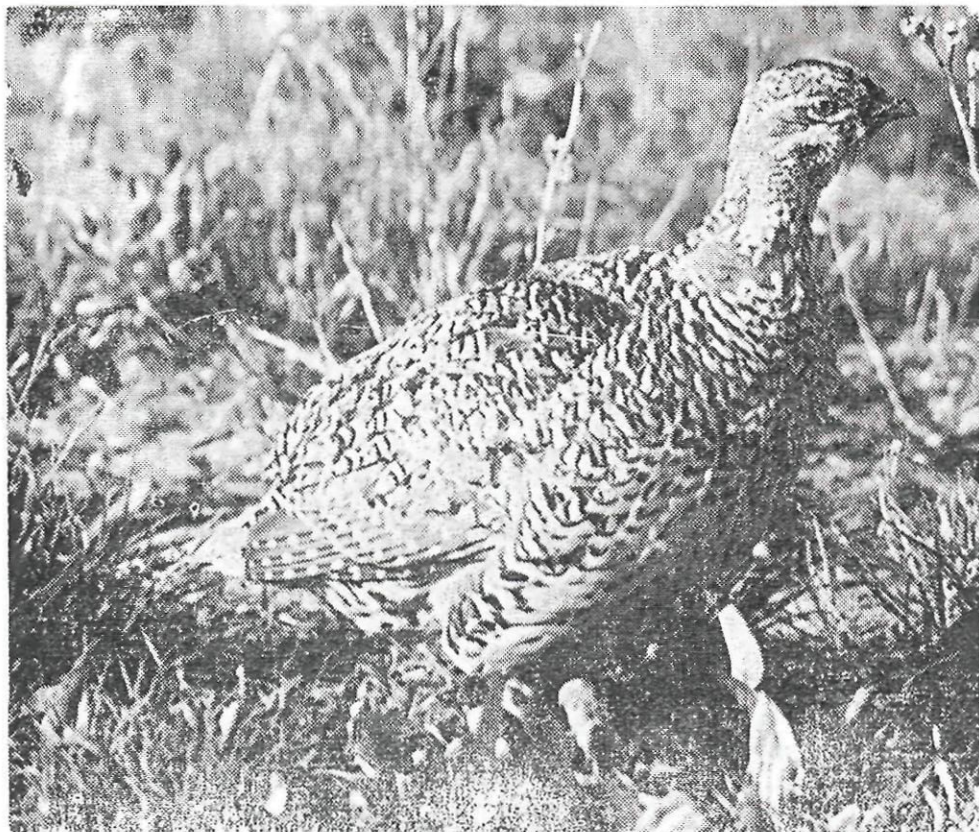


Figure 4. Columbian sharp-tailed grouse. Photo by Warren Peterson.

and benchland pastures which have not been severely overgrazed (Figure 5).

Population estimates indicate that two areas have comparatively greater numbers of sharp-tails than elsewhere in the state. These two areas of concentration are southern Cache Valley in Cache County, and northern Ogden Valley in Weber County. Eastern Box Elder County apparently has a comparatively large total population of sharp-tails but the birds are widely distributed over a large area. Thus, this latter area does not represent a concentration of birds comparable to the two areas mentioned above.

Scattered or isolated groups of sharp-tails remain in other parts of Cache, Weber, and Box Elder counties. Morgan County has a few sharp-tails, and a few are reported from Rich County.

In 1935, the total population of sharp-tailed grouse in Utah was estimated to be approximately 1,500. Four years later, in 1939, a second survey indicated that the sharp-tail population of the state had declined to approximately 1,155 birds, a decrease of 345. By 1948 sharp-tail numbers were estimated to have increased to approximately 1,515 (Table II). County and district populations apparently fluctuated considerably, with the Cache County population remaining the most stable. Census methods used were not accurate enough to provide an exact measure of the magnitude of the fluctuations, but it is evident that fluctuations or population shifts did occur.

The populations of the various species of grouse generally fluctuate periodically and are commonly said to be cyclic. However, Grange (1950:89-106) indicates that in Wisconsin the grouse cycle is quite clearly superimposed on the population levels which in turn are determined by the particular stage of the vegetation. Snyder (1935a: 7-12) presents information that indicates sharp-tailed grouse in Canada undergo periodic fluctuations in their populations with the peaks of numbers occurring at intervals of approximately 10 years. Early settlers in Utah state that there were alternating periods of abundance and scarcity in the sharp-tail populations here, with approximately 8 to 10 years in a cycle (Lee, 1936:49).

There is no sufficient information available to determine if the small sharp-tail population of Utah is subject to periodic fluctuations. Population estimates have not been made frequently enough or over a long enough period of time to give reliable data on this subject. The birds are so scarce that they are noticed infrequently by only a few farmers or other people, so that sampling the opinion of a section of the public would probably yield un-

satisfactory results. Under the present conditions, a more intensive longtime study of the sharp-tailed grouse in Utah would be necessary to determine if the population trends of these small, remnant groups follow those of the large, extensive populations that were formerly here, or that still remain elsewhere in North America.

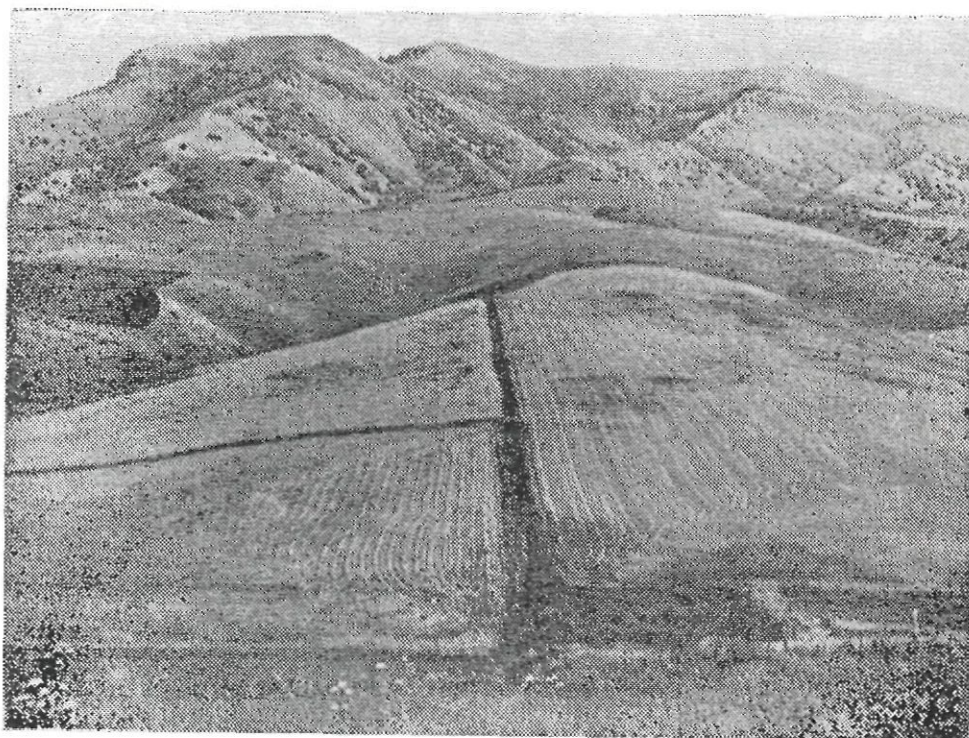


Figure 5. Typical terrain on the range of the sharp-tailed grouse, Southern Cache County, Utah.

TABLE II. SHARP-TAILED GROUSE POULATIONS IN UTAH
 BASED ON CENSUS AND ESTIMATES, 1935, 1939, and
 1948.

County	District	1935 (Lee, 1940b)	1939 (Lee, 1940b)	1948 (Hart, 1948)
Cache	Southwest	70	100(1)	
	Southeast	200	200	
	Northwest	45	85	
	Mendon	20	20	
	Hyde Park	35	15	
	Smithfield	—	45	
	Richmond	—	70	
	Total	370	335	350
Box Elder	Clark Range	200(2)	25	
	East of Blue Creek	100	50	
	East of Howell	25	25	
	West of Howell	—	50	
	Total	325	150	1000(2)
Weber	South End	50	100(1)	
	North End	500(2)	250	
	Total	550	350	150
Morgan	South End	35	85(1)	
	North End	20	20	
	Total	55	105	15
Rich	West of Bear Lake	200(2)	15	few
	Grand Total	1500	1135	1515

(1) New areas surveyed in 1939.

(2) Probably over-estimated.

LIFE HISTORY AND ECOLOGY OF COLUMBIAN SHARP-TAILED GROUSE

Reproductive Habits

Courtship. (1)

Members of the grouse family provide some of the most unusual and interesting sights to be viewed in nature when they become active in their spring courtship period. Like the drumming of the ruffed grouse, booming of the prairie chicken, and strutting of the sage hen, the courtship of the sharp-tail is a peculiar and spectacular performance. The antics of these birds in their elaborate exhibitions at selected spots in the spring have been likened to an Indian war dance, and it is not unreasonable to surmise that perhaps some of the Indian dances were originally inspired by those of our prairie grouse.

Sharp-tails are evidently promiscuous in breeding habits. They do not pair, but assemble on selected dancing grounds in the spring and perform en masse.

Persons afield the year-round in sharp-tail range and familiar with these birds state that dancing has been seen in nearly every month of the year, but the true mating activities and height of the dancing, in numbers and vigor of the birds taking part, occur during the spring.

Deming (1938:28) reported seeing tracks of dancing sharp-tails in the snow on January 22, 1938, and observed sharp-tails dancing in the snow on February 25, 1938. Marshall and Jenson (1937:96) observed that in 1937 dancing activities began in the last week in March and continued until about the first week in June. Lee's field notes for 1939 gave March 22 as the date of the earliest observed dancing, and May 29 as the latest date on which sharp-tail dancing was noted. April and May are usually considered the months of greatest courtship activity.

The dancing areas used by the sharp-tails are characteristic and seem to play an important part in the distribution of the birds. They are usually found on points of higher elevation, varying from small knolls to high hills, and usually in a weed-grass cover type. The vegetation is typically dominated by wheatgrasses (*Agropyron* spp.) and mule's ear dock (*Wyethia amplexicaulis*), with

(1) Except where otherwise indicated, most of the information in this section was taken from field notes of Oscar Deming, William H. Marshall, Orville S. Lee and Lynn Griner.

lesser amounts of associated grasses and weeds. Occasionally the sharp-tails will persist in using dancing grounds after they have been plowed up and planted in crops. Fifty-two dancing grounds located in north central Utah (35 in Cache County, 9 in Weber County, 4 in Box Elder County, and 4 in Morgan County) were classified as follows:

(a) Location	
On hills — definite elevation	32
On Flats — usually a slight rise only	20
(b) Vegetation	
Native vegetation	43
Cultivated fields	9

When the spring dancing activity begins, snow may still be on the ground. If the dancing ground is free of snow it usually presents a bare appearance, as a result of the winter rain and snow flattening the dead vegetation. Thus, there is little to interfere with the early dancing, and sharp-tails may dance over the entire area, although the majority of the birds tend to gather into a small portion of the dancing ground. Later in the spring, growth of the larger plants form obstacles so that the dancing is necessarily restricted to small open spots or bare pathways.

Dancing takes place both in the early morning and evening. The birds start coming on the dancing ground shortly before daylight. Marshall and Jenson (1937:96) observed that the period of dancing seems to be conditioned by light intensity (Table III). The duration of the morning dancing period is variable. At times the dancing is stopped shortly after sunrise, or may continue for 3 or 4 hours. The evening dancing period is during the last 1 to 3 hours before darkness. Dancing at this time usually is not marked by the vitality shown during the early morning period.

Weather conditions affect the dancing activity. Rains often inhibit the dancing, but apparently the dancing is not stopped by heavy dust storms.

The sharp-tails usually arrive at the dancing ground by walking. A few of the birds fly in, and some make a series of alternate short flights and walks. After the dancing period most of the sharp-tails walk away, but sometimes the entire flock makes a direct flight to distant cover or feeding grounds.

Disturbances usually cause only a temporary cessation of dancing activities. When airplanes, hawks, or other large birds, fly over, the sharp-tails "freeze" or flush and then fly away. A

TABLE III. RELATIONSHIP OF THE BEGINNING OF DANCING OF SHARP-TAILED GROUSE TO TIME OF SUNRISE (MARSHALL AND JENSON, 1937.)

Date	Dance Begins	Sunrise	Weather
4/26	4:52	5:35	Clear
4/27	4:52	5:34	Cloudy
4/28	4:53	5:33	Cloudy
4/29	4:52	5:31	Cloudy
5/3	4:38	5:26	Cloudy
5/16	4:30	5:11	Clear
5/17	4:23	5:10	Clear
5/27	4:15	5:03	Cloudy
5/29	4:03	5:02	Clear

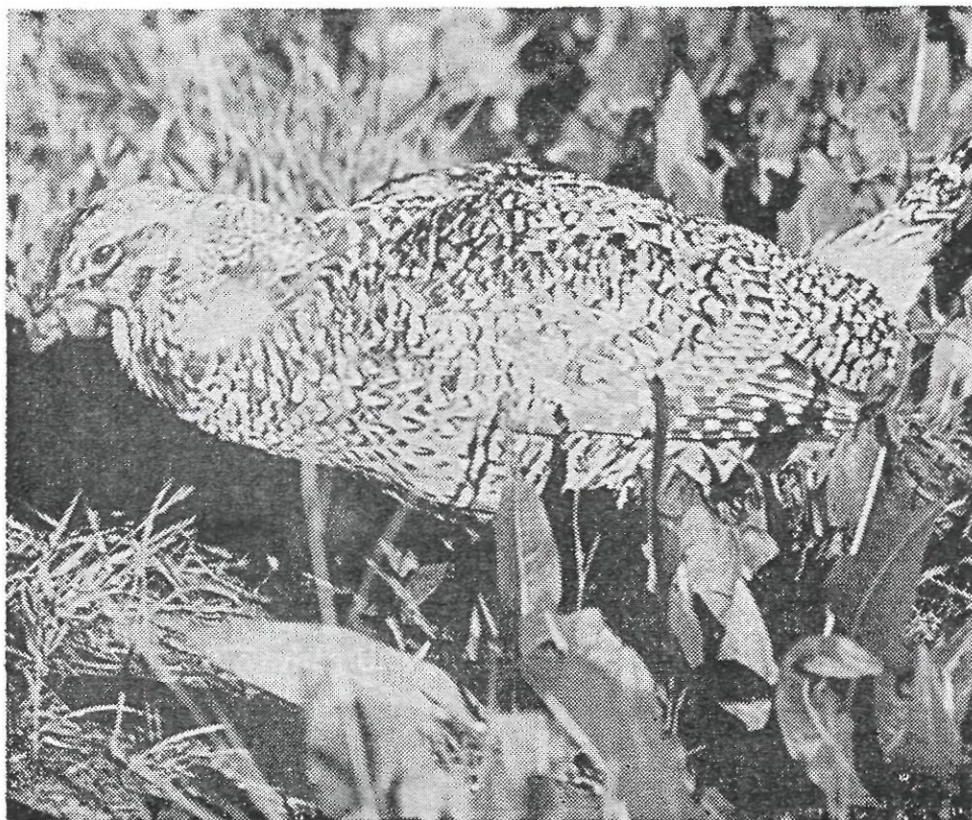


Figure 6. Inflated air sac on neck of dancing sharp-tailed grouse.

jack rabbit running through the dancing grounds causes the birds to flush. On one occasion, a coyote hidden in the weeds on the dancing ground was seen to dash out and catch a dancing sharp-tail, which of course, caused the others to flush. The sharp-tails are usually back dancing again within a few minutes after such disturbances.

Some observations of dancing sharp-tails were made from a car driven onto the dancing ground before the birds had arrived. The dancing apparently was not disturbed by the parked car, since birds danced as close to it as 20 feet.

The number of sharp-tails using a dancing ground varies with the population and the number of dancing grounds in an area. There is also a seasonal variation, with more birds dancing during the peak of the spring mating activity than at any other time. During recent years the number varied from a counted few to an estimated 100, but was usually less than 50. Counts made on 29 dancing grounds during the spring seasons from 1937 to 1939 showed a variation from 30 to 50 sharp-tails on a dancing ground, with an average of 12.2 birds for each courtship performance.

Description of dancing. The head is thrust out straight in front, with the outstretched neck showing an inflated purple air sac on each side (Figure 6); wings are extended horizontally and flutter slightly; the tail is erected fan-like over the back and is jerked rapidly back and forth and sideways, exposing the white rump feathers (Figure 7); the feathers on the body, feathers of the neck and crown of the head are erected. The eyebrow, a yellow-orange tissue becomes erect until it nearly covers the crown of the head. In this display position the bird suddenly rushes forward or rotates in a circle, with the feet stamping the ground in short, very rapid steps; the tail and wings vibrate so rapidly that the feather tips are a blur. These wild dashes are frequently interrupted by jumps or short flights a few feet into the air, followed by short dashes after the bird alights. The performance is accompanied by calls and a dry whirring sound, caused by the rapidly vibrating stiff tail feathers. The general effect is one of flashing white rumps and intense performers jumping, crossing, and passing each other.

The dancing continues for periods usually 50 to 30 seconds in length, alternating with periods of complete inactivity as the birds squat or stand motionless. During the most active part of the dancing periods at the height of the courtship season, the alternating periods of dancing and "freezing" are approximately equal. As time passes during the daily dancing periods and as the season

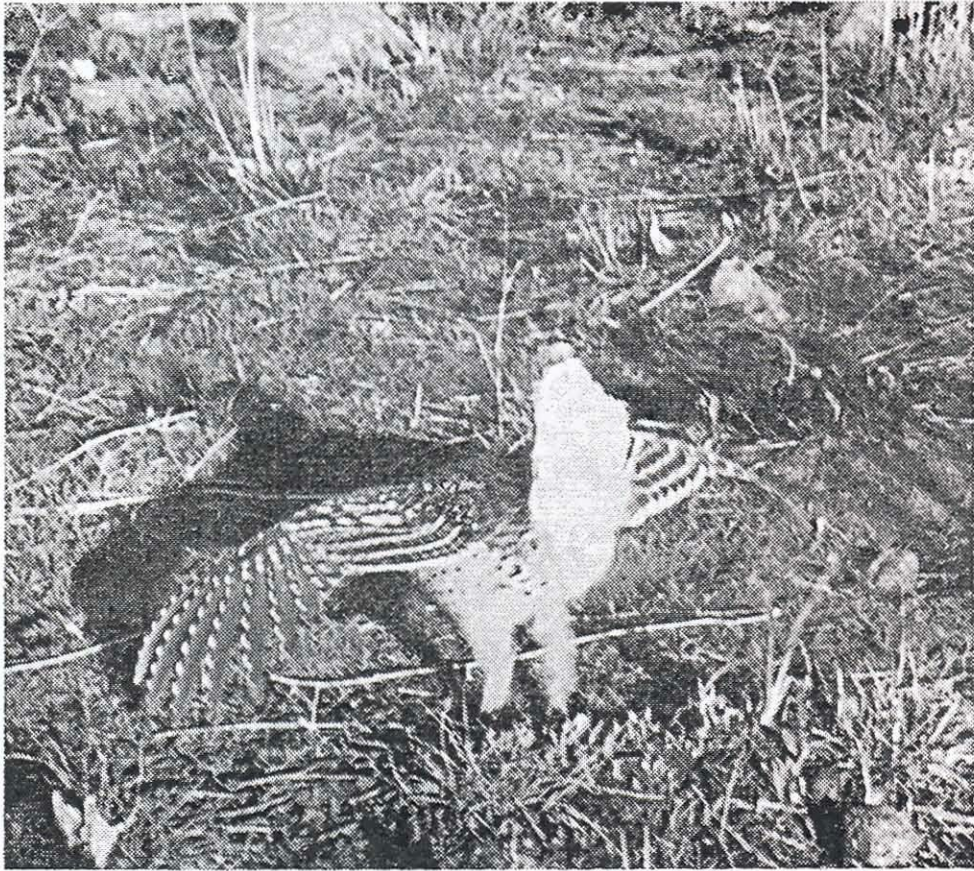


Figure 7. Dancing sharp-tailed grouse with white underpart of tail showing.

progresses, the dances grow shorter and the periods of inactivity grow longer, until the "freezes" last as long as 15 or 20 minutes.

The periods of dancing or "freezing" are general for birds on the dancing ground, but seem to be up to the whim of any of the sharp-tails. When one of the birds start to dance, it seems to be the signal for all of the sharp-tails in the vicinity to start, and the same procedure is true of stopping. The arrival of newcomers on the dancing ground causes the birds already dancing to put on a vigorous performance for a while.

Individual variations in the dance occur. Some birds do little more than dash in circles, while others are addicted to short, straight runs and vertical jumps. Some birds frequent the outer edge of the dancing ground and do little dancing.

Combat. Combat or bluffing frequently occurs. Two birds from several feet to several yards apart may eye one another and then

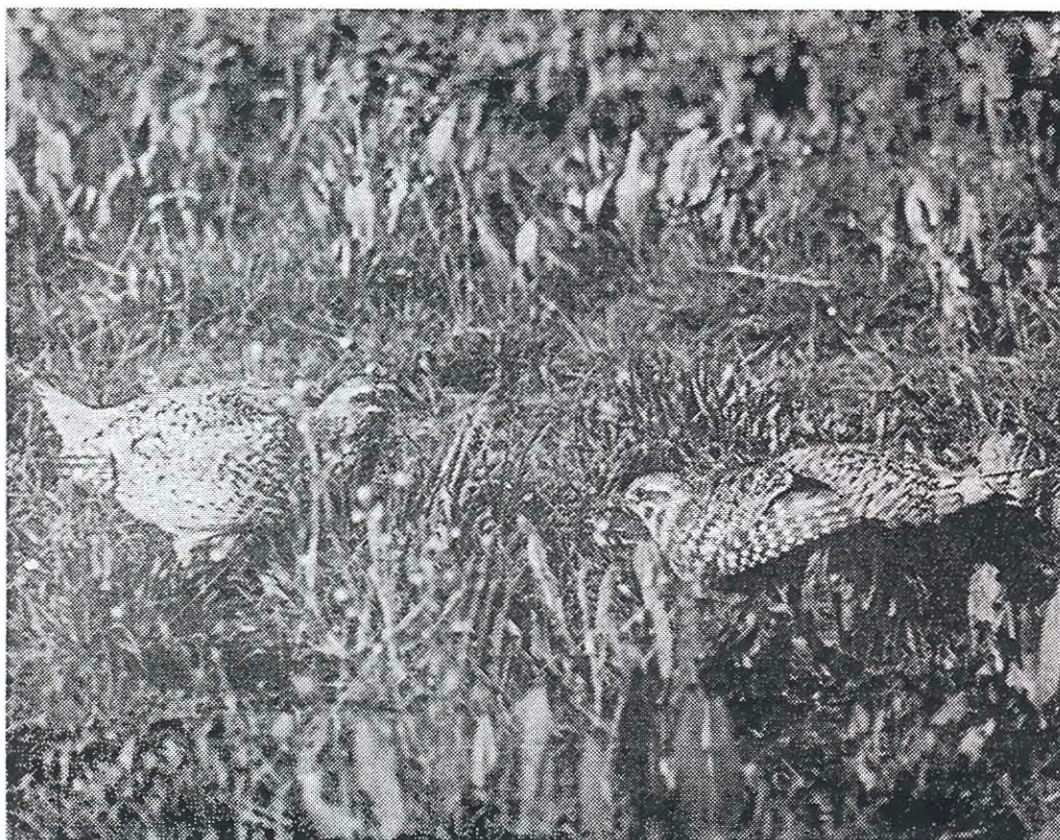


Figure 8. A pause is observed in the dance of two sharp-tailed grouse.

charge headlong at each other with head out-stretched and wings and tails extended. When it appears that a collision is imminent, the birds suddenly stop, with beaks almost touching. What happens then is variable. The two birds may squat with bills touching and remain motionless, with their tails and crowns becoming **normal in appearance**. After a short period of staring each other in the eye, one bird usually begins to watch some distant object and then rises to rejoin the dance, sometimes giving the other a hurried peck before drawing quickly away. If the birds do not squat, they usually sidestep about each other, suddenly spring into the air, bump breasts and wings, and fall back with wings fluttering to preserve their balance. They then lie motionless a short distance apart. After a few seconds, one bird may rise and walk away, or one may chase the other rapidly on foot or even in flight for a short distance. The fighting becomes more frequent and the flurries and chases become longer as the dancing season progresses. The fighting is apparently not of a nature that would establish an order of dominance among the dancers,

but seems to be caused by dispute over the dancing territory.

Calls. Another activity takes place on the dancing ground that is distinct from the actual dancing. At times a bird will stop dancing and, after resuming normal appearance, will move into the open or up on a small rock or clump of sagebrush. There the bird lowers its head, extends its neck out parallel with the body, and inflates the air sacs on the neck. In company to a jerky bobbing of the head up and down, a low hooting sound is made. This hooting is somewhat similar to that of a horned owl. It is usually made at regular intervals, but occasionally two or three notes are uttered in rapid succession. There is no visible movement or variation in the size of the air sacs while hooting. This peculiar calling may continue for several minutes before the bird resumes its dancing.

Other calls or sounds made by the sharp-tails during the course of the dancing period are varied. When the birds first enter the area, a throaty "kee-ow" or "kow" is repeated. During the dancing a rather continuous series of "cubble-up, cubble-up" is often heard. Several observers liken these calls to those of a domestic hen turkey. When the short vertical flights are made, the birds utter a cackle similar to the usual alarm call made when flushing. While some birds are hooting, others sometimes make a "cut-uck, cut-uck" noise. One observer states that a lone bird in company with two dancing pairs uttered "kee-ut, kee-ut" calls during the periods that the dancers were inactive.

As activities decrease toward the end of the dancing period, the birds one by one stop dancing and walk about aimlessly or feed on the available vegetation and insects, finally walking off the area.

Significance of the dance. Although interested individuals have spent hundreds of hours observing the dancing of sharp-tailed grouse from blinds in northern Utah, and the performance has been recorded on motion pictures, the exact significance of the exhibition and some other things about it are still not completely understood.

The part taken by the female sharp-tails in the courtship procedure is not definitely known, because of the difficulty of determining the sex of these birds in the field. Several observers are of the opinion that the birds actively dancing are males, and that the females are those birds which frequent the edge of the

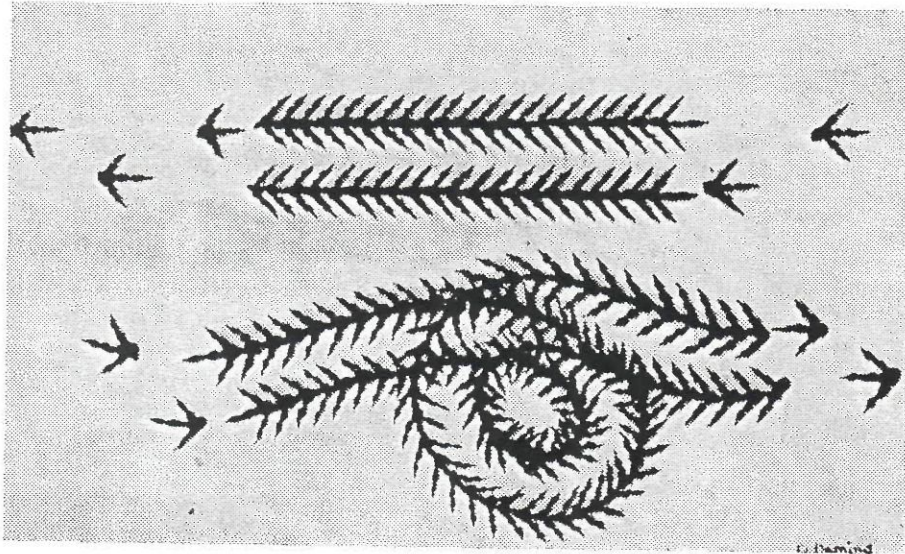


Figure 9. Tracks of dancing sharp-tailed grouse, Wellsville Grouse Refuge, January 22, 1938. Sketched from tracks in one-half inch snow.

dancing ground and occasionally make a half-hearted attempt at dancing. When one of these birds walks or runs across the dancing ground, the dancers center their interest upon the non-dancing bird and apparently try to out do each other in the intensity and vigor of their dance performances. However, a few observers are of the opinion that both sexes dance. This point of view is based upon observations that at times there is an apparent pairing off of dancing birds and that practically all birds are observed to be dancing.

From the available evidence, it seems most likely that the actively dancing birds are males, and that the main purpose of their performance is to attract the females to the vicinity of the dancing ground for mating. There are a few records of copulation being observed in Utah (Lee, 1940a:2).

In addition to attracting the opposite sex, the antics of the sharp-tails could reasonably be a type of contest among the males in vying for the favor of the females. It is evident that these birds are promiscuous in breeding habits. With all hens not starting to nest at the same time, the number of males in breeding condition will exceed the number of females ready to mate throughout most of the breeding season. These two factors indicate that some

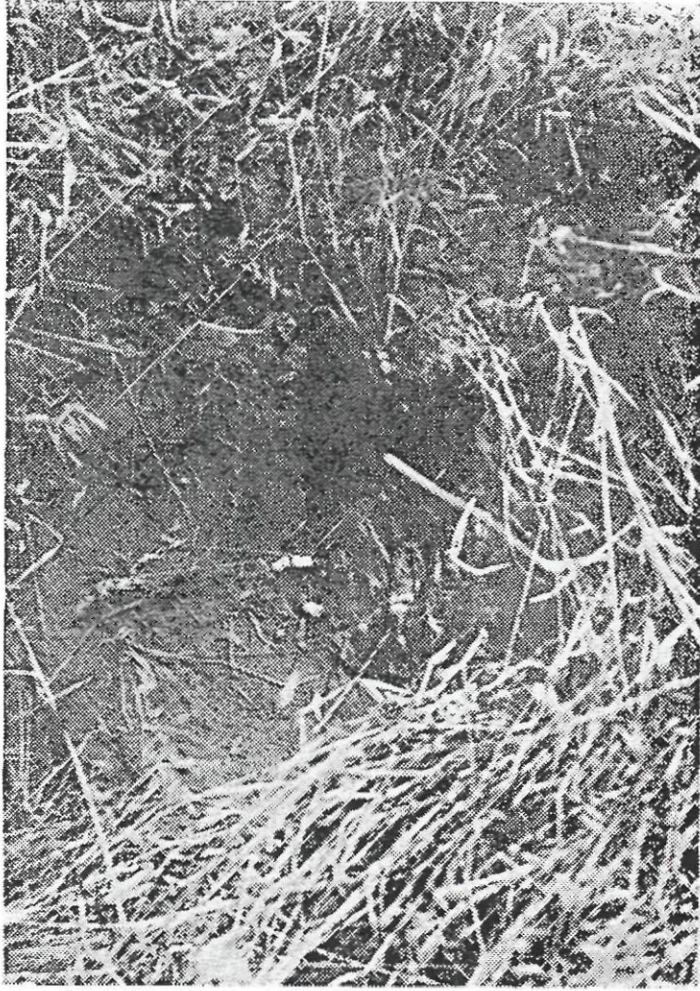


Figure 10. Trampling action of sharp-tailed grouse on their dance ground.

type of competition is inevitable among the males to determine which shall serve the females

Nesting.

The nesting season of the sharp-tails generally begins soon after the spring courtship period is underway, and continues for a short time after the dancing stops. The date varies somewhat with spring weather, but is usually from April to early July with the peak of the hatch occurring in late May or early June.

Nests are located in the hills, benchlands, or adjacent slopes which are frequented by the sharp-tails during most of the year. Nests are frequently found in unplowed and unburned vegetation along fence rows.

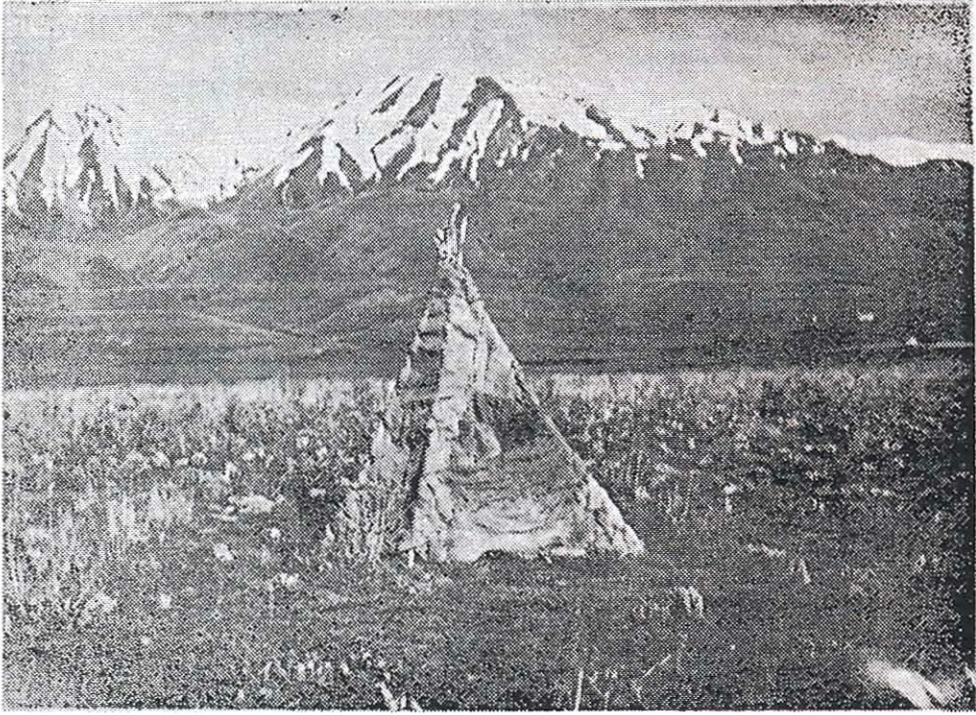


Figure 11. A early photographic blind on the sharp-tailed grouse dancing ground, Wellsville Refuge, Utah.

The nest site chosen is frequently in alfalfa or stubble fields, and less commonly in native vegetation. This may be caused to some extent by the general lack of native vegetation which affords good nesting cover, but alfalfa is evidently highly attractive to the bird for nesting purposes. Of 127 sharp-tail nests observed from 1935 to 1940, 52.7 percent were in alfalfa, 26.8 percent were in wheat stubble, and only 18.1 percent were in native vegetation (Table IV).

The important plant species of the native vegetation which form desirable nesting cover are: beardless wheat grass (*Agropyron inerme*), cut-leaf balsam (*Balsamorhiza macrophylla*), mule's ear or dock (*Wyethia amplexicaulis*), and sagebrush (*Artemesia tridentata*).

The nest consists of a rounded depression one to three inches in depth and four to six inches in diameter, lined sparsely with grass, plant stems or leaves, and a few feathers (Figure 12). When the nest is in native vegetation, it is usually placed beside or beneath some cover, such as a grass clump, sagebrush, or a herbaceous plant.

Eggs. A full clutch of eggs normally varies from 10 to 13 in number. The largest clutch found by Lee (1940a:2) was 17 eggs,

TABLE IV. NESTING COVER, SIZE OF CLUTCH, AND FATE OF SHARP-TAILED GROUSE NESTS FOUND IN NORTH CENTRAL UTAH FROM 1935 TO 1940.

Year	Where found	Nests		Average Clutch	Fate of Nests Hatched		Fate of Nests Destroyed		Fate of Nests Undetermined	
		No.	%		No.	%	No.	%	No.	%
1935 (Lee, 1936)	stubble fields(1)	6	40.0	—	—	—	—	—	6	40.0
	alfalfa fields	5	33.3	—	—	—	—	—	5	33.3
	grain fields	2	13.3	—	—	—	—	—	2	13.3
	weeds	1	6.7	—	—	—	—	—	1	6.7
	native vegetation	1	6.7	—	—	—	—	—	1	6.7
	1935 totals	15	100.0	—	—	—	—	—	15	100.0
1936(2)	native vegetation	4	66.7	11.3	1	25.0	2	50.0	1	25.0
	alfalfa	2	33.3	10.5	—	—	1	50.0	1	50.0
	1936 totals	6	100.0	11.0	1	16.7	3	50.0	2	33.3
1937 (Lee, 1940a)	native vegetation	1	8.3	9	1	100.0	0	0.0	0	0.0
	alfalfa fields	9	75.0	7-13	3	33.3	6	66.7	0	0.0
	stubble fields	2	16.7	—	0	0.0	2	100.0	0	0.0
	1937 totals	12	100.0	9.8	4	33.3	8	66.7	0	0.0
1938 (Lee, 1940a)	native vegetation	1	5.5	9	1	100.0	0	0.0	0	0.0
	alfalfa fields	17	94.5	9-17	7	41.2	10	58.8	0	0.0
	1938 totals	18	100.0	12.2	8	44.5	10	55.5	0	0.0
1939 (Lee, 1940a)	native vegetation	8	14.0	3-15	7	87.5	1	12.5	0	0.0
	alfalfa fields	28	49.1	6-14	13	46.4	15	53.5	0	0.0
	stubble fields	21	36.9	—	0	0.0	21	100.0	0	0.0
	1939 totals	57	100.0	11	20	35.0	37	65.0	0	0.0
1940 (Lee, 1940a)	native vegetation	8	42.0	10	6	75.0	2	25.0	0	0.0
	alfalfa fields	6	31.6	10	2	33.3	4	66.7	0	0.0
	stubble fields	5	26.4	—	0	0.0	5	100.0	0	0.0
	1940 totals	19	100.0	10	8	42.1	11	57.9	0	0.0
1935-40	native vegetation	23	18.1	—	16	69.5	5	21.8	2	8.7
	alfalfa fields	67	52.7	—	25	37.3	36	53.7	6	9.0
	stubble fields	34	26.8	—	0	0.0	28	82.3	6	17.7
	grain fields	2	1.6	—	—	—	—	—	2	100.0
	weeds	1	0.8	—	—	—	—	—	1	100.0
	Grand totals	127	100.0	approx. 11	41	32.3	69	54.3	17	13.4

(1) Nests found in the stubble of the previous year's grain crops.

(2) From field notes of W. H. Marshall.

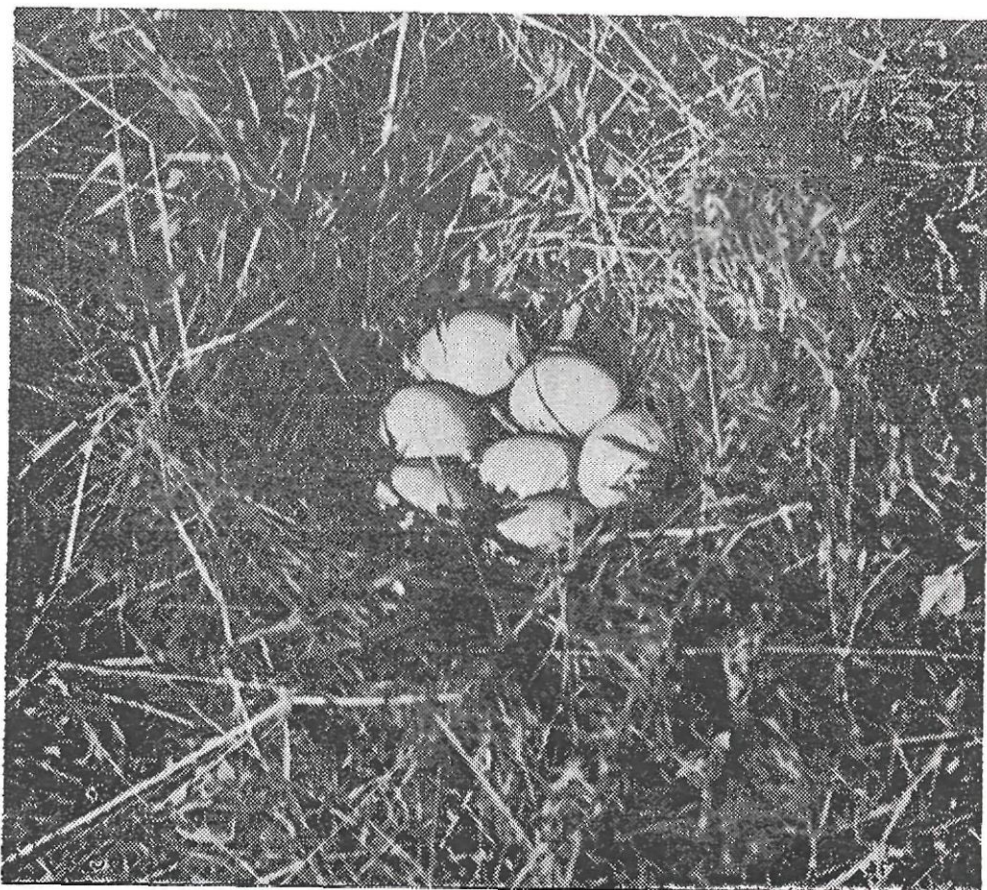


Figure 12. Sharp-tailed grouse nest and eggs.

and the average clutch of 127 nests observed was approximately 11 eggs (Table IV). In color the eggs are an irregular olive with a slight amount of pale blue sometimes showing through, and with a light variable speckling of dark chocolate brown. Sharp-tail eggs are about the same size as pheasant eggs; 14 eggs averaged 44.5 by 34 millimeters.

Incubation and hatching. The incubation period of the sharp-tail is about 21 days (Bent, 1932:294; Grinnell, Bryant, and Storer, 1918: 563). Incubation is done entirely by the female. The males are usually found in groups of two to five at this time of the year and do not assume any parental duties.

The hen generally leaves the nest to feed for approximately 30 to 45 minutes in the morning and again in the evening. She usually does not range more than 200 yards from the nest.

There is no evidence that sharp-tails raise more than one brood per year. It is probable that early nesting hens whose nests

have been destroyed may re-nest, but there is no definite information on this subject. For re-nestings to be productive, it seems they would necessarily have to start before the spring dancing period is over, but more information on mating is necessary to clarify this point.

Sharp-tail nests are frequently destroyed by mowing and plowing, or by predators. Of the nests under observation, those in stubble fields of the previous year's grain crop suffered the greatest destruction (82.3 percent), and losses were also high in alfalfa (52.7 percent). Nearly 70 percent of the total nests located in the native vegetation, however, successfully hatched (Figure 13).

The true percentage of nests in alfalfa and stubble that are destroyed probably is somewhat less than indicated by the figures in Table IV. Many of the nests in these cultivated fields were found as they were destroyed, while nests that had already hatched may have gone unnoticed. However, it is obvious that nests

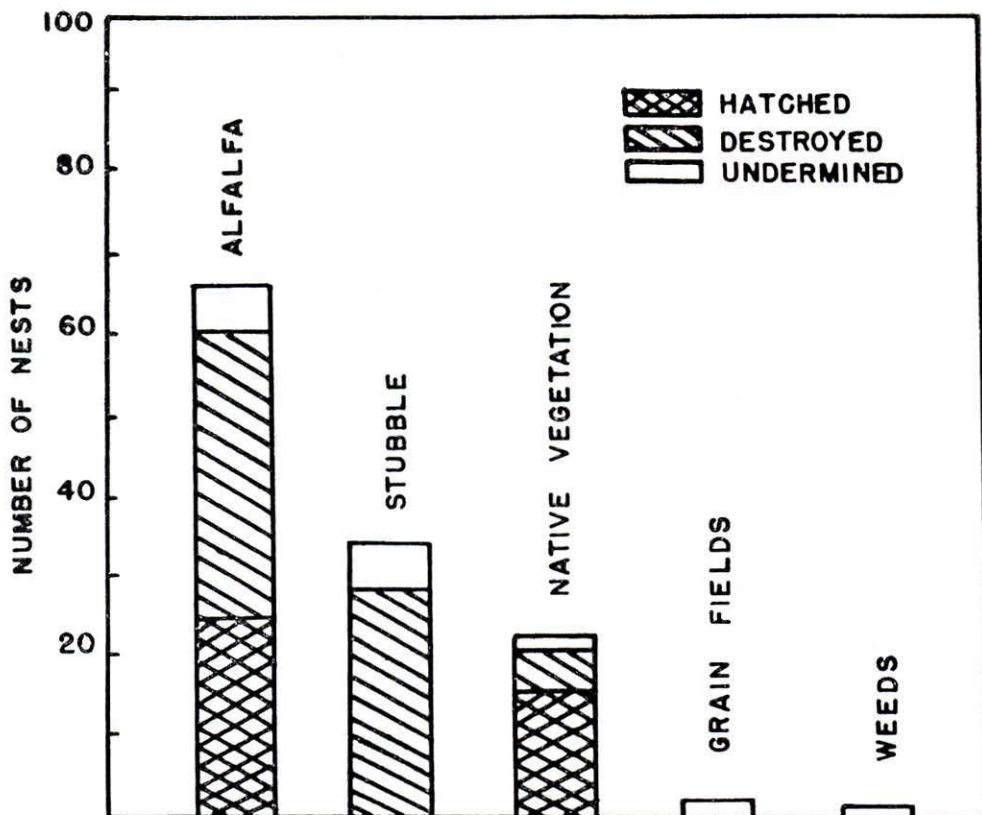


Figure 13. Nesting cover and fate of 127 sharp-tailed grouse nests observed in northern Utah, 1935-40.

in cultivated fields are in a precarious position, and are usually successful only when unusual climatic conditions cause the nesting season to be well advanced before spring plowing and hay mowing are started.

Rearing of young.

Sharp-tail chicks are precocial: they are able to walk soon after hatching, and are nimble and very active at two or three days of age.

General coloration of the chicks is a pale yellow with dark brown to black spots and blotches on the back, neck and the top of the head. The base color of the back tends to be more of a yellowish brown, with 4 dark brown to black bars running longitudinally along the rear part of the back.

The legs are covered with short down, with patches of down between the forward pointing toes. The primary wing feathers emerge from their sheaths and start growing during the first day of life.

Average measurements taken from two sharp-tail chicks found dead in or near the nest soon after hatching are given in Table V; weights were 14.7 and 15.1 grams.

Chicks a day or two old make a faint peeping cry when the hen is flushed while brooding them. Older chicks are silent under these conditions, but make a shrill peeping cry as they flush or when they are captured. Between two and three months of age the juveniles start cackling similarly to the adults when flushed. Juveniles have been heard to utter a "cooing" sound at night.

TABLE V. MEASUREMENTS OF JUVENILE SHARP-TAILED GROUSE, SOUTHERN CACHE COUNTY, UTAH, 1948.

Measurement	AGE		
	1 day(1)	5 days(2)	21 days(2)
Head	28 mm.	35 mm.	40 mm.
Wing	34 mm.	65 mm.	145 mm.
Foot	39 mm.	45 mm.	66 mm.
Total length	85 mm.	112 mm.	163 mm.

(1) Average measurements from 2 specimens.

(2) Measurements from single specimens.

Maternal care. All parental duties are taken care of by the female sharp-tail. She is a devoted mother, ordinarily leaving her nest or brood of young chicks only after being closely approached; and then feigning injuries, she attempts to lead the intruder away. The hen has been reported to fly at sheep to scare them away.

The mother broods the young chicks in the vicinity of the nest for a day or two after the eggs hatch. When the chicks are strong enough to travel, she may lead them considerable distances from places of danger or from places where they may have been molested. The hen usually makes energetic decoy attempts to lead the intruder away when a brood of young sharp-tails is found. If followed, the hen will flop along the ground until 50 to 75 yards away from the brood location and then fly away. If the brood is too young to fly or if they hide rather than fly, the mother will usually reappear within five minutes, walking back to the area where the young birds are hiding. If the hen is not pursued when the decoying attempt is made, she will usually remain in the vicinity of the brood, running about with her head held forward and low, the wings partially raised from the sides, and uttering the characteristic cackle or a nasal croaking sound.

In general, the younger the brood, the closer the hen must be approached to cause her to flush. When the juveniles are able to fly strongly, the hen and brood usually flush almost simultaneously, with the hen making no decoy attempt.

The hen remains with the brood all summer; after that, the brood-and-hen identity is lost in the formation of coveys during the fall and winter.

Development and habits. The young grouse have excellent protective coloration and depend upon it rather strongly during the first two or three weeks of their life (Figure 14). A brood not more than one or two days old, after being disturbed while the hen was brooding it, was found walking about through the weeds and grass, making faint peeping crys, and making no attempt to hide. When the same brood was found two days later, the chicks remained well hidden and did not utter a sound. Young of a hidden brood have shown no indication of becoming impatient to move about or cry out after being watched as long as 30 minutes.

After they are able to fly, the juveniles still prefer to hide rather than to fly, and are usually hard to flush until their powers of flight approach those of the adults. They generally make one rather short flight when flushed during this early age, and if the



Figure 14. Hiding sharp-tailed grouse chick, approximately 10 days of age.

location is carefully marked, can be frequently picked up.

When broods of young sharp-tails are found during the day, they are usually scattered about the hen within a radius of approximately 2 to 15 feet, foraging or squatting in the shade of grass and weed clumps.

Young sharp-tails grow very rapidly (Table V). Their wing feathers develop quickly and they are able to fly short distances at 7 to 10 days of age. At the age of 1 month they are about one-fourth grown, and can make flights of approximately 50 yards. At this age, the wings, back, sides, and upper legs are well feathered, but the tail feathers are very short. The rest of the body is still covered with down.

When the juveniles have reached two months of age, they are approximately two-thirds grown. They appear completely feathered but often have a "ragged" appearance about the head, neck and tail feathers. The crest is not yet conspicuous and the central tail feathers are short. At this age their flight is fairly strong and they are capable of flying long distances. They have the habits of the adults in dusting and resting in the shade of the shrubs and bushes during the mid-day period.

When three months of age, they are apparently mature. In size, flight, and habits, the younger birds are so much like the

adults that it is very difficult to distinguish them from the old birds in the field. The juveniles lack the longer central tail feathers that give the "sharp-tail" appearance, but many of the adults at that date lack these tail feathers or have short ones because of molting.

Survival. Sharp-tail young suffer the same general type and degree of mortality that frequently befalls the juveniles of upland game birds in agricultural areas. Some are killed by farming practices, inclement weather, miscellaneous accidents, predators, and possibly by disease. It is not known which of these is the most important cause of juvenile loss, but mortality caused by farm implements is most conspicuous. During the period from 1937 to 1939, a total of 150 broods of sharp-tails were found in the fields during the spring and early summer. The average brood size was 8.7. Seven of the hens, or 4.7 percent, had been killed by farm implements, while losses to juveniles totaled 14 birds or 1 percent.

Brood counts made throughout the summer of 1948 near Paradise indicated that mortality of juvenile sharp-tails was greatest during the first month of life. Counts showed that broods averaged 8.5 juveniles when the birds were less than one month of age, but the average dropped to 4.6 juveniles per brood after they had reached one month of age, and remained at that average for the rest of the summer (Table VI and Figure 15). This indicates a survival of 56 percent of the juveniles from the age of less than one month to an age of more than two months.

It is difficult to obtain an accurate count of the number of sharp-tail chicks in a brood when they are not old enough to fly well, and many counts of young broods must be discarded because of suspected inaccuracies. Their excellent protective coloration and ability to hide makes it practically impossible to find all of the members of a hiding brood. A trained bird dog is extremely useful in locating and flushing broods of juveniles able to fly, so that complete counts may be made.

Adult-juvenile ratios obtained at the same time but on a monthly basis agreed in general with the results of the brood counts. Juvenile mortality was greatest during the early summer, and declined as the summer progressed (Table VI). The adult-juvenile population ratio and the average brood size obtained during the same month (August) indicated that approximately 21 percent of the adult population were hens successful in rearing a brood to two months of age, assuming that adult sex-ratios were approximately equal.

TABLE VI. COMPARISON OF ADULT AND JUVENILE SHARP-TAIL POPULATIONS IN PARADISE AREA, NORTHERN UTAH, SUMMER OF 1948 (HART, 1948).

	June		July		August	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
No. of birds counted	52	71	55	60	87	83
Ratio	1:	1.37	1:	1.09	1:	0.95
% of population	42.2	57.8	47.8	52.2	51.2	48.8

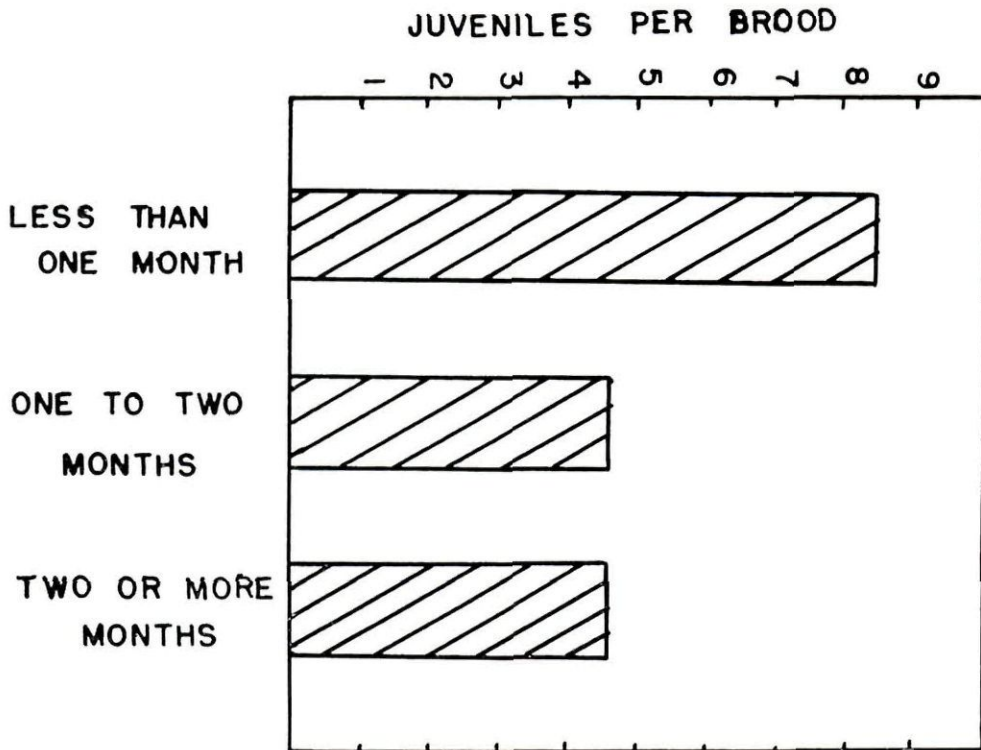


Figure 15. Average number of juvenile sharp-tailed grouse per brood at various ages, in northern Utah, 1948.

"General Habits"

Feed and Feeding Habits.

Resting and dusting.

During the spring, summer, and fall, sharp-tails spend the time between the morning and afternoon feeding periods in resting and dusting. In winter the birds spend most of the daytime feeding; snow cover and frozen ground prevent dusting.

Dusting and resting forms are usually found near the base of grass clumps or weeds (forbs), or underneath shrubs and bushes. The dusting forms resemble those made by pheasants, but can be distinguished by the sharp-tail droppings and feathers that litter the vicinity (Figure 16).

During the spring and early summer, sharp-tails show a preference for resting and dusting in the shade of weeds and grasses. Marshall and Jenson (1937:93) found 52.5 percent of the resting forms in April under grasses and weeds. Hart (1948:36 found, in a different area, that in June 84.4 percent of the resting birds were using weed and grass cover. After dusting, the birds may continue to rest in the dusting form or will move a few feet and make their resting form in more dense shade.

In later summer, about mid-July, leaves of most herbaceous

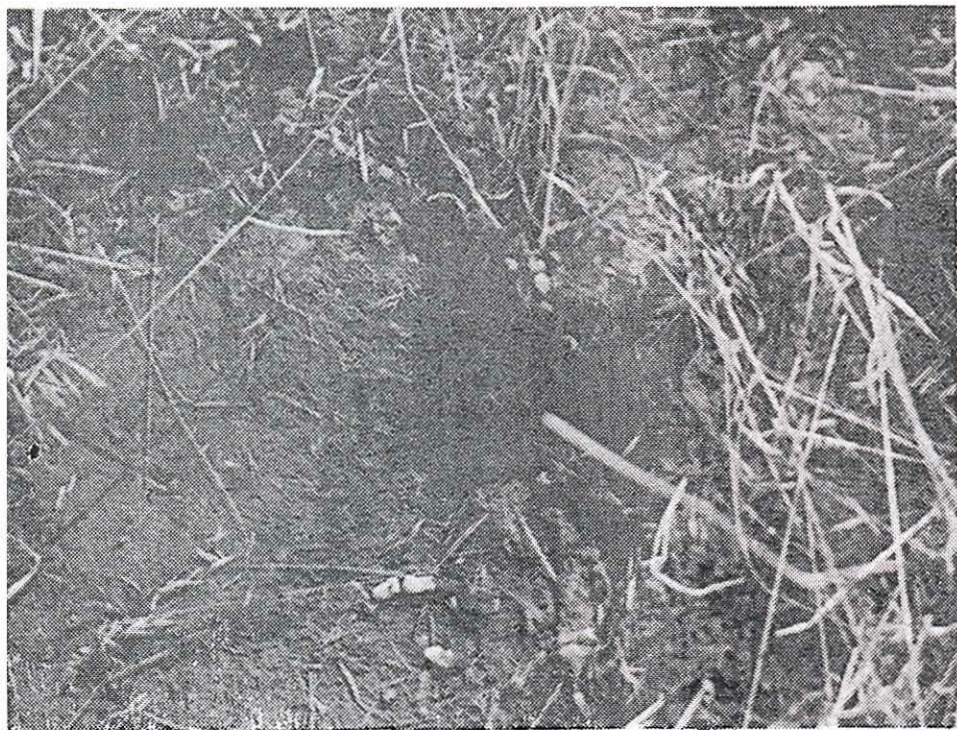


Figure 16. Dusting grounds of sharp-tailed grouse.

plants in sharp-tail range die and curl up, which reduces the amount and density of shade in weed and grass cover. Higher daytime temperatures which occur then apparently increase the desire and need of the birds for shade during the mid-day. The result is that the sharp-tails generally start using shrubs and bushes for resting and dusting cover sometime in July, with the use of this cover becoming more prevalent in August. Sixty percent of resting birds found in July were under shrubs and bushes, while in August this percentage increased to 95. Chokecherry (*Prunus melanocarpa*) is apparently the most desirable plant for shade, but sagebrush (*Artemisa tridentata*) is also used a great deal. Availability of cover types or particular plant species often governs the actions of these birds on the range, rather than any preference they may exhibit.

Sounds and calls.

Groups of sharp-tailed grouse at times become rather noisy. When spread out while feeding the individuals in a group will often cackle and cluck, making a general noise that has been compared to that made by a flock of domestic chickens.

The cackle made by the birds as they flush is the sound most frequently heard. This call consists of a rapidly uttered series of "kucks" or "kacks" usually lasting two or three seconds, but variable in length. The sharp-tails make this cackle when they flush and repeat it with each series of wing beats for some distance. Observing this gives the impression that the cackle is involuntary and caused by the wing beats forcefully expelling air from the bird's lungs. However, birds have often been observed in flight when they did not cackle, and this call is sometimes uttered when the birds are on the ground. This apparently is an alarm call, being also commonly uttered by hen sharp-tails when disturbed in the presence of their brood. A slightly modified cackle is often used by birds calling to one another. Sharp-tails cackling while on the ground hold the bill open slightly, with the neck just below the bill and air sacs at the sides of the upper neck pulsating rapidly, and the tail vibrating.

Another sound sometimes given by hens when their broods are molested is a nasal croak similar to that often made by domestic hens.

A captive female sharp-tail made sounds decidedly similar to those made by a contented domestic hen, described as soft, musical "c-o-u-c-k", "cluck."

Walking.

Although the sharp-tails are excellent fliers, they or-

dinarily prefer walking to flying, and fly only when disturbed, when it appears desirable to cover comparatively long distances, or when they wish to reach something above the ground.

If the feeding areas or dancing grounds are close to desirable roosting cover, the birds commonly walk between the roosts and places of late evening and early morning activity. When feeding, these birds walk or run about and fly up only to obtain berries or buds from bushes and trees. Sharp-tails have been observed walking or running from one bare spot of ground to the next to feed in partially snow-covered stubble fields, not flying over the intervening snow-covered ground even though the bare spots were sometimes 200 yards apart. Other inclinations of the birds to walk have been previously mentioned.

In spite of this seeming preference for walking, the sharp-tails rarely run, as pheasants may, to escape danger; they nearly always fly when disturbed.

Flight.

The sharp-tailed grouse has a strong but characteristic flight. It usually squats and then gives a strong, upward spring to launch itself, rising at an angle to an altitude anywhere between 5 feet and 40 or 50 feet, and then levels off and moves away in a rather direct flight. For approximately 30 to 50 yards after flushing, the bird flies vigorously, but following this the flight consists of short periods of sailing on outstretched wings, alternating with bursts of wing beats.

The wing beats appear to be alternate and cause the bird to rock and twist back and forth. Slow motion moving pictures, however, show that the wing beats are actually simultaneous, rather than alternating.

A cackle is uttered when the birds flush and with each burst of wing beats for some distance in flight. Wing beats used in getting underway in flight make a whirring sound that can be heard for 100 yards or more under favorable conditions. Sharp-tails passing overhead on long flights are practically noiseless.

The average speed of flight of sharp-tails was determined to be between 30 and 35 m.p.h. by Deming (1938:20-25) who timed the flights of these birds with a stop-watch over paced distances. Flight speeds were 5 to 10 m.p.h. slower than those determined for the pheasant by the same methods. Sharp-tails accelerated in flight until they had gone 135 to 200 yards, obtaining a maximum flying speed of 46 m.p.h. with a light tail wind.

Short flights are sometimes made, but the usual distance flown is one-fourth to one-half mile. The sharp-tails are strong fliers; flights of two or three miles in length are not unusual, and

flights of undetermined length have been observed where the birds came into view and then passed out of sight in the opposite direction without lighting (Low and Gaufin, 1946:8).

Roosting.

Roosting habits vary considerably with season and local conditions. During the warm seasons, the birds leave the roost before daylight to dance or feed. They normally stay on the roost site until later in the morning in cold weather, and will stay there all day in inclement weather during the winter.

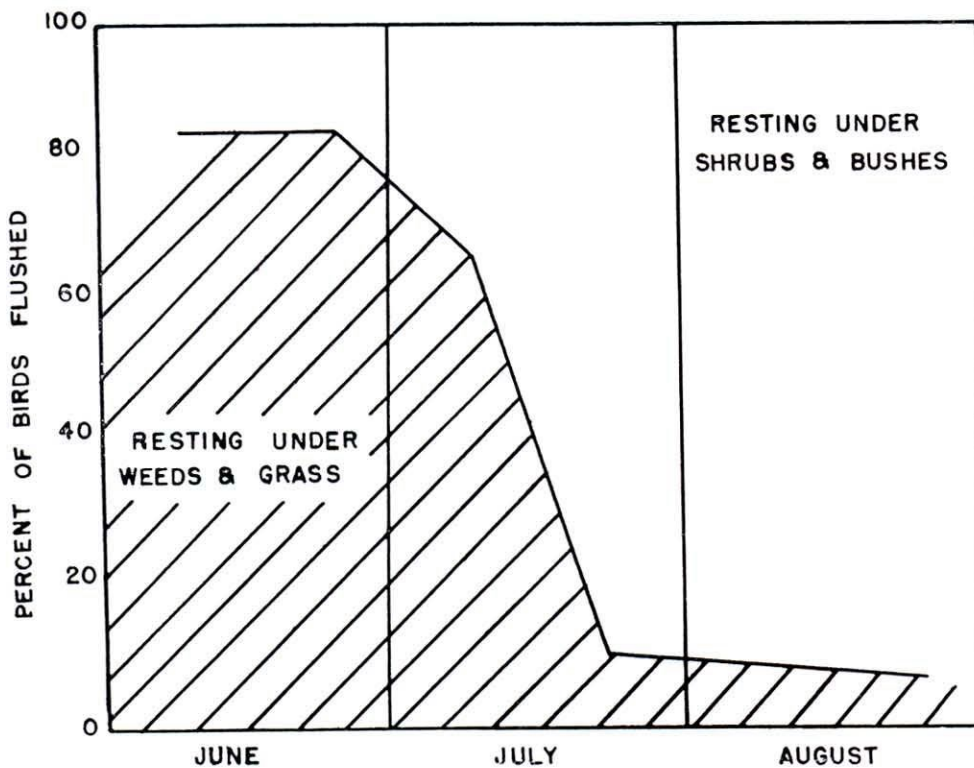


Figure 17. Relative use of weeds and grass compared to shrubs and bushes for resting shade by sharp-tailed grouse in northern Utah, summer of 1948.

Roosting places are usually chosen near the crest of a ridge or top of a hill. A preferred roosting site may be used several times, but it seems that the sharp-tails commonly roost at the closest suitable spot when darkness approaches. The roosting form resembles a resting form, but typically has a rather compact pile of the usual dropping and one or more large, dark, moist droppings to one side of the form.

During the summer, the sharp-tails ordinarily spend the

night on the ground in weed-grass cover or under sagebrush or chokecherry. They roost singly or in groups of as many as five or six birds.

During the fall, winter, and early spring, the sharp-tails commonly roost in larger groups corresponding to their covey formations during those seasons. The birds scatter out on the roost, averaging about six feet apart, but are sometimes as close together as one foot. In fall and spring, roosting forms are frequently in weeds or grass at the base of sagebrush. When snow is deep, they generally roost in or next to maple or chokecherry bushes.

The sharp-tails seem to prefer to roost on the ground when vegetation or soft snow is available in which to partially conceal themselves. When the snow is crusted, and occasionally at other times, the birds pass the night on low limbs of shrubs and trees. They frequently dive or burrow into deep, loose snow and roost in tunnels under the snow surface. The tunnels are about 7 to 8 inches in diameter, from 6 to 18 inches under the snow surface, and up to 10 feet in length. Heavy snows may completely cover roosting birds so that there is no outward trace of their presence. This habit of roosting under soft snow gives the sharp-tails protection against subfreezing temperatures. Although there is no direct evidence, they may occasionally be trapped and killed by the formation of a crust on the snow surface.

Movements.

Distances by the sharp-tailed grouse depend primarily upon the proximity of the various cover types needed by the birds in their daily or seasonal activities. They are capable of walking or flying considerable distances to obtain food or cover when this is necessary.

The daily cruising radius varies with the seasons, and is generally reduced by inclement weather. In the summer it is rather short, because food and cover are generally plentiful and close together in the sharp-tail habitat. At this season the birds may range daily over a radius of less than 100 yards to as much as one-fourth of a mile. During the fall, the daily cruising radius usually becomes greater, and often varies from one-fourth mile to one and one-half miles. In winter the reduced and scattered food supply may require the sharp-tails to range for a radius of two miles to obtain sufficient nourishment. Jenson (1937:28) reports that sharp-tails traveled three-fourths of a mile on foot in less than three hours while feeding during February. In the spring, the more plentiful food supply and the dancing activity cause the daily range to be reduced to a maximum

of approximately one mile.

The annual cruising radius does not greatly exceed that occurring during the winter. The range inhabited during the spring, summer, and early fall generally varies but slightly as agricultural practices and seasonal changes in vegetation make it necessary. However, during the winter when deep snow is on the ground, the sharp-tails are sometimes forced to shift their range a distance of as much as two or three miles to favorable food and shelter.

Sharp-tails in some areas, especially Canada, are migratory to a certain degree, sometimes moving long distances in winter (Aldous, 1943:26; Snyder, 1935a:14). Such migrations do not occur in the Columbian sharp-tail population in Utah, but there is evidence that some unexplained movements of unknown length are made by these birds. On at least two occasions in recent years, small flocks of sharp-tails have been seen to fly north out of sight from south-eastern Cache Valley (Low and Gaufin, 1946:8). This suggests that there is some trading back and forth between isolated areas of sharp-tail habitat in Utah, or that there are outward movements from the areas having comparatively high density populations.

Flocking habits.

The sharp-tailed grouse is usually found singly or in small groups during the summer, and in large coveys from fall until spring. The sharp-tail covey organization and range are not so characteristic or fixed as they are with the bobwhite and western quail, the usual examples of covey-forming birds. The sharp-tail covey, if it may be termed that, is a rather loose aggregation of birds with apparently no definite organization or number.

During the summer of 1948, adult males or non-nesting females were found singly or in groups as large as 12. The larger groups were comparatively rare; most of the sharp-tails were flushed singly or in groups of two or three. The larger groups evidently resulted from the sharp-tails concentrating at a few preferred shady spots to spend the mid-day resting and dusting. Family groups (hen and brood) averaged six sharp-tails in number after the juveniles were over one month of age. However, this is a natural family unit rather than the result of flocking.

The sharp-tails start flocking sometime during the early fall, probably during the month of September. In southern Cache Valley, the sharp-tails had not yet started flocking by late August, 1948. On October 8, a flock of 42 sharp-tails was flushed at



Figure 18. "Snow nest" of sharp-tailed grouse in four inches of snow.

dusk from grain stubble south of Wellsville. In the evening of October 13, another large concentration of sharp-tails was observed at the same place. An estimated total of 80 grouse was flushed, with approximately 50 birds in the largest of three flocks.

There is a wide variation in the size of flocks or coveys. Groups of three or less sharp-tails were flushed throughout the fall, winter, and spring of 1936-37. The average covey was largest in the fall, and early winter, varying from 13 to 36 birds per covey (Table VII). The average covey size decreased in mid-December, and varied from three to eight in number from then until the end of February. Coveys were found to be somewhat larger again during the spring, averaging from 4 to 18 birds (Marshall and Jenson, 1937:93).

The large coveys of sharp-tails that occur during the fall and early winter are evidently the result of the birds concentrating in and around the grain stubble fields where food is plentiful. When deep snow makes food difficult to find, sharp-tails apparently are forced to scatter and range over larger areas to obtain sufficient nourishment. In the spring, food becomes more available, and sharp-tails tend to concentrate in the vicinity of the dancing grounds, so that the covey size increases again. When the dancing season is over, the hens are scattered and nesting, and the males disperse or remain in small groups in the general vicinity of the dancing grounds.

Splitting and reassembling of various groups of sharp-tails occur throughout the season, and groupings at any one time apparently are largely a matter of chance. Coveys apparently have no acknowledged leader and follow any bird that moves first or takes the lead. The following observation by Jenson (1937:-26) illustrates the uniting and splitting that occurs with sharp-tail groups:

On March 13, 1937, eight sharp-tails were sighted with field glasses. They walked a short distance to wheat stubble and within ten minutes, thirty five birds had congregated from all directions where none had been. These birds were tracked and flushed at 11:00 A. M.; to my surprise there were seventy birds by now. They flushed in bunches of 25, 15, 15, and 15 going in three different directions.

Wariness.

Field observations show that the sharp-tailed grouse is one of the most wary upland game birds in Utah, even though this bird has not been legally hunted for over 25 years. Men who have had the pleasure of hunting the sharp-tails when they were legal game generally agree that the birds were shy and difficult to bag after they had been subjected to hunting.

The flushing distance of the sharp-tails is generally greatest during the winter, tends to decrease progressively during the spring to a low in the early summer, and then increase again during the late summer and fall (Table VIII). Monthly fluctuations from this pattern occur because of the variables noted above. The average flushing distance is shortest during the early summer probably because the plant growth at that season provides plentiful, dense cover for the sharp-tails. Mowing of hay in early summer reduces the total amount of available cover, and

later in the summer the cover becomes even more sparse in areas of native vegetation because annuals and the tops of many perennial herbaceous plants dry up and wither. In late summer and fall, harvesting of grain and plowing of stubble further reduce the total area and density of the cover available to the birds. The advent of snow apparently increases visibility of both the sharp-tails and intruders to each other so that flushing distances are increased. During the fall and winter, pheasant and rabbit hunting in or near areas inhabited by the sharp-tails also tends to make them wilder. Some flushing distances may be very short during the winter when the sharp-tails dive or tunnel into snow, which has the effect of hiding them like dense cover. In the spring the melting snow and growth of native plants and crops make more cover available which increases in density as summer approaches.

Food and feeding habits

Feeding habits.

Sharp-tails normally have two feeding periods a day during the warm seasons of the year. During the spring, the birds feed after the morning dance is over and again before the evening dance is started. In summer and fall, the feeding is done in the early morning and late afternoon or evening, with the middle of the day spent in resting and dusting. In winter, the birds generally stay on the roost late and feed during the middle of the day.

When food is available on the ground, the sharp-tails feed by walking rapidly or running along, picking up their food as they move. They stretch to reach weed seeds, flower petals, or other food above the ground or snow surface, but do not jump to obtain food. They go from one bare spot of ground to the next while feeding when snow partially covers the ground. The sharp-tails rarely, if ever, scratch for food, even when the snow is very shallow. On one occasion, tunnels were found in soft snow over wheat stubble where it was evident that the birds had been feeding on wheat (Jenson, 1937:6). Apparently the sharp-tails in this instance accidentally happened on this source of food when making roosting tunnels, for there is no other evidence of these birds tunneling in snow for food.

As the snow depth increases, sharp-tails are able to reach increasingly higher levels of food by walking on the snow surface. When the snow finally becomes deep enough to cover sagebrush and other shrubby food plants, the sharp-tails are forced to move

TABLE VII. AVERAGE COVEY SIZE OF SHARP-TAILED GROUSE IN NORTHERN UTAH DURING THE LATE FALL, WINTER AND SPRING OF 1936-37 (MARSHALL AND JENSON, 1937:90, 93.)

Date	Average covey size
Oct. 13-31	32.3
Nov. 1-15	12.7
Nov. 16-30	17.3
Dec. 1-15	35.9
Dec. 16-31	2.7
Jan. 1-15	—
Jan. 16-31	4.9
Feb. 1-15	6.7
Feb. 16-28	8.3
Mar. 1-15	18.0
Mar. 16-31	13.3
Apr. 1-15	3.8
Apr. 16-30	5.6
May 1-15	9.6
May 16-31	6.1

TABLE VIII. AVERAGE FLUSHING DISTANCES OF SHARP-TAILED GROUSE IN NORTHERN UTAH, 1936 to 1938 (DEMING, 1938; MARSHALL, n. d.).

Season	Average flushing distance (feet)							
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
1936-37	66	38	132	138	60	86	45	20
1937-38	—	35	95	206	92	51	—	—

to taller cover, where they feed on buds. They reach the buds from the snow surfaces, or fly up and perch on the limbs to feed.

This movement to obtain buds for food is usually to a high-elevation, but in some localities the reverse may be true. The



Figure 19. Sharp-tailed grouse trails in the snow leading to a clump of choke-cherry. Note "snow nest" in lower right hand corner.

sharp-tails in Ogden Valley have moved down into Eden during the winter to feed on buds in the poplar trees lining the streets of the town.

Food preference.

Food habits of the prairie sharp-tailed grouse have been studied in Nebraska by Swenk and Selko (1938), and in Michigan by Baumgartner (1939), in Wisconsin by Schmidt (1936), in Minnesota by Swanson (1940), and in North Dakota by Aldous (1943). In Utah food habits studies of the Columbian sharp-tailed grouse have been made by a number of workers including Lee (1936), Deming (1938), Marshall and Jenson (1937), and Hart (1948). Additional data are also available on food studies made by various students.

Studies of food habits on the sharp-tails in Utah have been made principally by observing the birds in the field and by analyzing fecal droppings. The crops and stomachs of a few sharp-tailed grouse killed in accidents or by predators have been analy-

zed. Because of the comparative scarcity of birds none have been collected for food habits studies.

Autumn food of the prairie sharp-tails in Nebraska (Swenk and Selko, 1938:186, 188) has been shown to consist mainly of vegetable matter of which leaves made up 45 percent, seeds 38 percent, and animal matter, largely insects, 0.28 percent. Early winter food of the grouse in Utah as shown by limited crop and stomach analysis consisted 100 percent of vegetable matter, largely of waste wheat and knotweed seeds (Table IX).

Dropping analysis indicates that seeds of both weeds and domestic plants were used throughout the fall, winter, and spring while insects and leafy materials were a more important part of the diet in the summer (Table X). Buds of chokecherry, mountain mahogany, and serviceberry appear in the diet only in the winter period.

Food habits items of juvenile birds in summer indicated that insect material constituted from 80 to 100 per cent of the diet of juvenile sharp-tailed grouse up to two or three weeks of age. Green grass leaves are eaten to some extent by the juveniles no, more than four to five days of age (Table XI).

During the late fall and early part of the winter, waste grain and other plant seeds on the ground make up a large part of the diet when the birds move into the grain fields. This habit was known by hunters in the early days and wheat fields were the principal hunting areas.

As snow covers the ground the diet changes to one having quantities of sunflowers, stoneseed (*Lithospermum ruderales*), sagebrush seed heads and leaves and other plants above the ground. As the snow depth increases the diet is supplemented by such items as wild rose seeds, willow, poplar, maple, chokecherry, and serviceberry buds. Chokecherry and serviceberry appear to furnish the preferred buds. Maple, which is most abundant, is seldom eaten. It has been observed that birds "budded" on the serviceberries and chokecherries interspersed among the maples and carefully avoid the maple buds.

The food of the grouse appears to be influenced considerably by the availability of the food items. Thus, the winter food habits vary directly with the severity of the winter, largely reflected by the depth of snow. By the middle of the normal winter of 1938-39 all but three sharp-tails had left the Bankhead-McBride area on the Wellsville Preserve, while during the unusually mild winter of 1939-40 from 30 to 40 sharp-tails remained

on the same area all winter. It appears that winter movements of sharp-tails are influenced, if not instigated, by the type of weather and the availability of food. Frequently sharp-tails will remain all winter in the same habitat as in summer if necessary food and cover are available. The monthly rank of principal foods, based on frequency of use, throughout the year indicated a definite pattern based on availability and preference (Table XII).

TABLE IX. ANALYSIS OF THREE STOMACHS AND ONE CROP OF SHARP-TAILED GROUSE, CACHE COUNTY, UTAH DECEMBER, 1937.

Type of Food	Crop		Stomach	
	Number of Items	1	Number of Items	2 3
<u>Vegetable matter</u>				
Wheat (seeds)	182	6		
Wheat (sprouted)	2	2		
Knotweed (<i>Polygonum douglasii</i>)	154	125	134	numerous
Knotweed	684	25		numerous
Wheat husks and beards	numerous	numerous	numerous	
Amaranth (seeds) (<i>Amaranthus</i>)		1		
Rose hips (<i>Rosa sp.</i>)				few
Grass leaves (<i>Poa sp.</i>)				few
Sunflower (<i>Helianthella sp.</i>)				several
Kitchen weed (<i>Gayophytum</i>)				few
Grit	8	145	258	63

The monthly rank of principal foods as determined by combining all food habits work by observation and crop analysis is shown in Table XII. The importance of the native bunch-grass vegetation to these birds is shown by the fact that grass

TABLE X. RELATIVE ABUNDANCE OF FOOD ITEMS IN SHARP-TAILED GROUSE DROPPINGS, SOUTHERN CACHE COUNTY, UTAH, 1935-48.

Item	Estimated Bulk Rating
Plant Material	
Grass seeds	1
Knotweed seeds	2
Grass leaves	3
Mahogany seeds	4
Rose seeds	5
Chokecherry fruits	6
Stoneseed seeds	7
Snowberry seeds	8
Sagebrush leaves	9
Sagebrush seed heads	10
Chokecherry buds	11
Wild lettuce seeds	trace
Knapweed seeds	trace
Moss	trace
Maple buds	trace
Alfalfa leaves	trace
Animal Material	
Beetles	1
Grasshoppers	2
Bugs	3

TABLE XI. FOOD ITEMS IN JUVENILE SHARP-TAILED GROUSE DROPPINGS, JUNE 25 TO JULY 14, 1948: CACHE COUNTY, UTAH.

Estimated age of juveniles	Date	Items in Droppings (estimated per cent of total volume)	
4-5 days	June 25	Insects	95
		Grasshoppers	95
		Vegetation	5
		Grass blades	5
5-6 days	June 26	Insects	95
		Grasshoppers	90
		Beetles	5
		Vegetation	5
		Grass blades	2
2 weeks	July 14	Unidentified veg.	3
		Insects	80
		Grasshoppers	50
		Unidentified	30
		Vegetation	20
		Grass blades	5
		Stoneseed seed	5
2-3 weeks	June 29	Unidentified	10
		Insects	100
		Grasshoppers	100

seeds and leaves rank first or second in the diet from May through December, with February, when grasses are covered by snow, the only month when they are lacking in the diet.

Habitat requirements

Topography.

The sharp-tailed grouse of Utah are generally found where hills, benchlands, or other areas of rolling topography exist. Extremely steep or rough areas are seldom used by the birds. Summer observations showed little use of areas by sharp-tails where the slope was greater than 30 to 35 degrees.

It is probable that topography has little effect upon the distribution and activities of sharp-tails except as it influences vegetation, snow depth, cultivation by man, and selection of dancing grounds. It seems that these birds will use nearly any topography

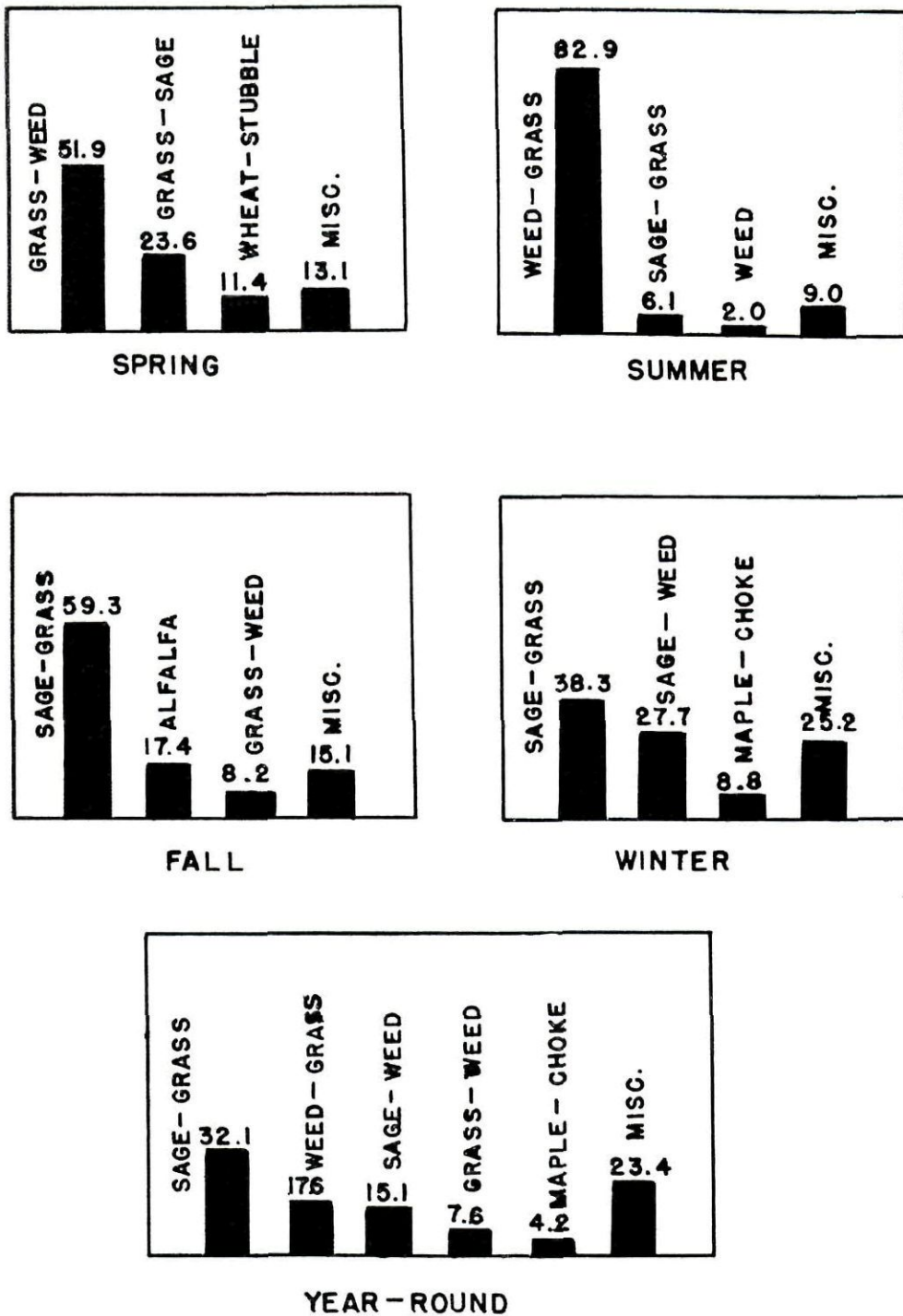


Figure 20. Cover plants used by the sharp-tailed grouse in northern Utah.

TABLE XII. RELATIVE MONTHLY RANK OF PRINCIPAL FOODS OF SHARP-TAILED GROUSE IN NORTHERN UTAH, 1936-48. BASED ON SIGHT OBSERVATIONS, STOMACH AND DROPPING ANALYSES.

Month	Food Plants (Probable rank)
January	<ol style="list-style-type: none"> 1. chokecherry buds 2. serviceberry buds 3. knotweed seeds 4. grass seeds and leaves 5. wheat seeds
February	<ol style="list-style-type: none"> 1. chokecherry buds 2. serviceberry buds 3. rose 4. sunflower seeds
March	<ol style="list-style-type: none"> 1. wheat seeds 2. grass seeds 3. sunflower seeds 4. sagebrush seed heads
April	<ol style="list-style-type: none"> 1. wheat 2. alfalfa 3. grass 4. insects
May	<ol style="list-style-type: none"> 1. alfalfa 2. grass leaves 3. wheat seeds 4. Wyethia
June, July, August	<ol style="list-style-type: none"> 1. grass seeds and leaves 2. insects 3. sagebrush leaves and seed heads 4. alfalfa leaves 5. chokecherry fruit
September	<ol style="list-style-type: none"> 1. grass seeds and leaves 2. chokecherry fruit 3. snowberry seeds 4. insects
October	<ol style="list-style-type: none"> 1. grass seeds and leaves 2. wheat 3. sunflower 4. wild rose hips
November	<ol style="list-style-type: none"> 1. wheat 2. grass seeds and leaves 3. sunflower 4. knotweed

December	1. wheat
	2. grass seeds
	3. knotweed
	4. sunflower

that offers them the necessities of food and shelter. Generally the rolling lands unsuited to crop land is all that is left for the birds.

Vegetation.

The climax vegetation of the foothills and benchland in northern Utah is bunch grass and associated species (Weaver and Clements, 1938:15-16). This is corroborated by the writings and testimony of early settlers and visitors in this region which state that grasses and various berry producing shrubs were very abundant (Hovey, 1923:9, 132, 137; Lee, 1936:-24). It is evident that this climax-bunch grass vegetation was favorable to the sharp-tails because of the large numbers of these birds that were found in the bunch grass areas during the pioneer days, and also because the remaining sharp-tail populations generally occur only where remnants of the climax vegetation are found. Records of cover types from which 2008 sharp-tails were flushed during all seasons of the year in northern Utah from 1936 to 1948 show that 1,258 birds, or 62.6 percent of the total, were in cover types in which grasses were dominant or were an important constituent.

The following list of plants includes the most abundant or important plant species found on typical sharp-tail range east of Paradise, Utah, during the summer of 1948. This list is typical of most sharp-tail habitat in northern Utah, but there is some variation with locality.

Grasses

- Wheatgrass — *Agropyron inerme* or *A. spicatum*
- Cheat grass — *Bromus tectorum*
- Sandberg bluegrass — *Poa secunda*
- June grass — *Koeleria cristata*
- Oniongrass — *Melica bulbosa*
- Giant Wild-rye — *Elymus condensatus*

Weeds or forbs

- Mule Ears or dock — *Wyethia amplexicaulis*
- Cut-leaf balsam — *Balsamorhiza macrophylla*
- Little Sunflower — *Helianthella uniflora*
- Lupine — *Lupinus* spp.

Balsamroot — *Balsamorhiza sagittata*
Cudweed sagewort — *Artemisia gnaphalodes*
Yarrow — *Archillea lanulosa*
Buckwheat — *Eriogonum* spp.
Knotweed — *Polygonum Douglasii*
Sunflower — *Helianthus annuus*

Shrubs or trees

Sagebrush — *Artemisia tridentata*
Chokecherry — *Prunus melanocarpa*
Maple — *Acer* spp.
Rose — *Rosa* spp.
Hawthorn — *Crataegus rivularis*
Serviceberry — *Amelanchier alnifolia*
Mountain Mahogany — *Cercocarpus montanus*

Combinations of the two groups of weeds and grasses, or of one or both of these groups with sagebrush make up the important cover types on the sharp-tail range, with the exception of the maple-chokecherry cover. Cover in which weeds or grasses predominate is used considerably more than other cover types during the spring and summer, while sagebrush-grass and sagebrush-weed cover rank highest in use during the fall and winter. Maple-chokecherry is used for winter cover and food (Table XIII and Figure 22).

Properly managed grazing land in bunch grasses and associated species fulfills the requirements for sharp-tail habitat, as well as these are known at present. A fairly dense growth of perennial grasses, composites, and associated plants provide food and cover for most activities of the birds during seasons when the ground is free of snow. Scattered clumps of sagebrush and chokecherry provide escape cover, shade during the summer, shelter during later fall and winter, and food during various times of the year. Tall shrubs or small trees, such as chokecherry, serviceberry, and maple, are essential for winter cover to provide food and shelter for the sharp-tails when snow has covered sagebrush and other plants of low to moderate height.

Water.

Water requirements of the sharp-tailed grouse in the west are not clearly understood. Some farmers state that they have observed sharp-tails go to water and drink, but, on the contrary, sharp-tails have been observed to live away from water for indefinite periods, and there is no apparent correlation between the presence of water and the range of the birds during any season. Sharp-tails observed throughout the summer of 1948 ap-

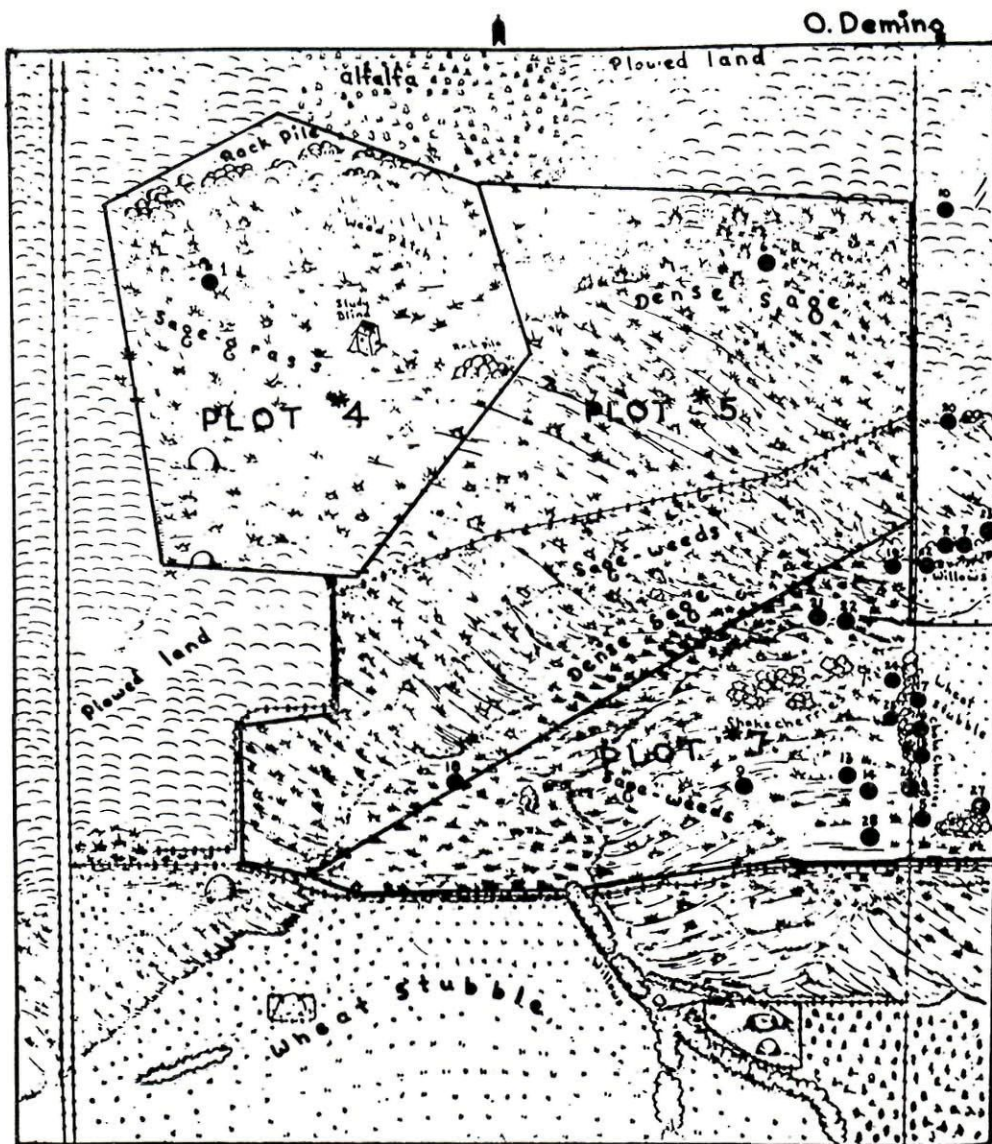


Figure 21. Schematic presentation of a typical sharp-tailed grouse range including dancing grounds, nesting, brood rearing cover, and food plots.

parently did not make use of the only source of free water in their range, a small pond surrounded by soft mud which would have revealed their tracks if they had used the water. Jenson (1937:15) states that during the fall there was never any correlation found between drinking water and sharp-tail range, and that during the winter the birds seldom approached within one and one-half miles of drinking water. It seems that rain, dew, snow, and succulent vegetation are the primary sources of water for the sharp-tailed grouse.

TABLE XIII. USE OF COVER TYPES BY COLUMBIAN SHARP-TAILED GROUSE IN NORTHERN UTAH, 1936-1948, BASED ON PERCENT OF BIRDS FLUSHED (DEMING, 1938; HART, 1948; JENSON, 1937).

Period	Number of birds flushed	COVER TYPES											
		Weed	Weed-grass	Weed-sagebrush	Grass-weed	Grass-sagebrush	Sagebrush-weed	Sagebrush-grass	Maple-chokecherry	Willow	Alfalfa	Wheat Stubble	Miscellaneous
Summer	408	2.0	82.9	—	—	—	1.7	6.1	0.2	—	1.2	—	5.9
June	138	2.2	79.7	—	—	—	5.1	8.7	—	—	0.7	—	3.6
July	105	—	96.2	—	—	—	—	—	—	—	3.8	—	—
August	165	3.0	76.9	—	—	—	—	7.9	0.6	—	—	—	11.6
Fall	402	—	—	—	8.2	—	5.7	59.3	—	1.0	17.4	2.2	6.2
September(1)	—	—	—	—	—	—	—	—	—	—	—	—	—
October	97	—	—	—	—	—	—	27.8	—	—	72.2	—	—
November	305	—	—	—	10.8	—	7.5	69.2	—	1.3	—	3.0	8.2
Winter	969	3.9	1.6	7.9	—	—	27.7	38.3	8.8	4.4	—	—	7.4
December	460	—	—	16.8	—	—	40.5	35.4	3.0	0.4	—	—	3.9
January	224	0.9	—	—	—	—	13.8	42.0	24.6	16.5	—	—	2.2
February	285	12.7	5.3	—	—	—	17.8	40.0	5.6	1.4	—	—	17.2
Spring	229	—	—	—	51.9	23.6	1.7	3.5	—	—	—	11.4	7.9
March	217	—	—	—	54.8	24.9	—	—	—	—	—	12.0	8.3
April	8	—	—	—	—	—	50.0	50.0	—	—	—	—	—
May	4	—	—	—	—	—	—	50.0	—	—	—	—	—
TOTALS	2008	2.3	17.6	3.8	7.6	2.7	15.1	32.1	4.2	2.3	3.7	1.7	6.9

(1) No data available.

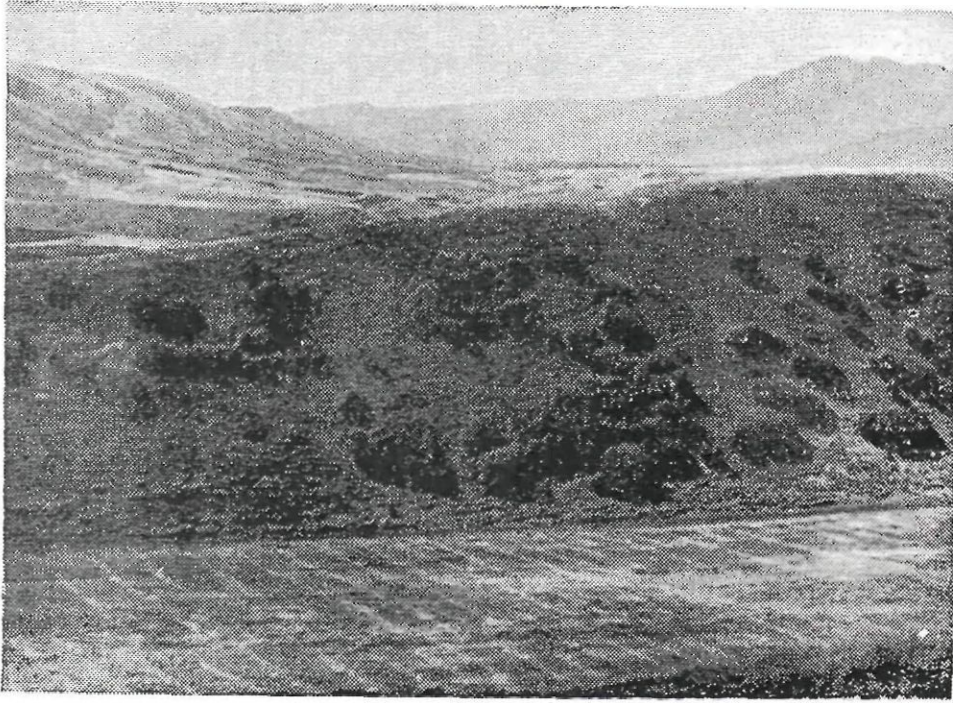


Figure 22. Maples and sagebrush on the steep hillsides form important sharp-tailed grouse habitat. Photo by L. A. Stoddart.

Limiting factors

The principal factors which have been responsible for the decrease of the Columbian sharp-tail in Utah are those resulting from the activities of man. The sharp-tail does not readily adapt itself to living in an area of intensive agricultural use. During pioneer days cultivation of a small portion of the sharp-tail range possibly was beneficial to the birds, the hay and grain crops resulting in a more diversified habitat and new sources of food without a serious loss of native habitat. However, as the area of sharp-tail range put to agricultural use by man became increasingly great, the result was decidedly detrimental to these birds.

Cultivation.

The sharp-tailed grouse has been more adversely affected by the advent of cultivation in Utah than possibly any other native game bird. Nearly all of the natural habitat of this grouse has been appropriated by man for agricultural purposes. Much of it has been cultivated as dry-farm grain and hay land, or for irrigated crops.

The decrease of the sharp-tail habitat in Utah because of

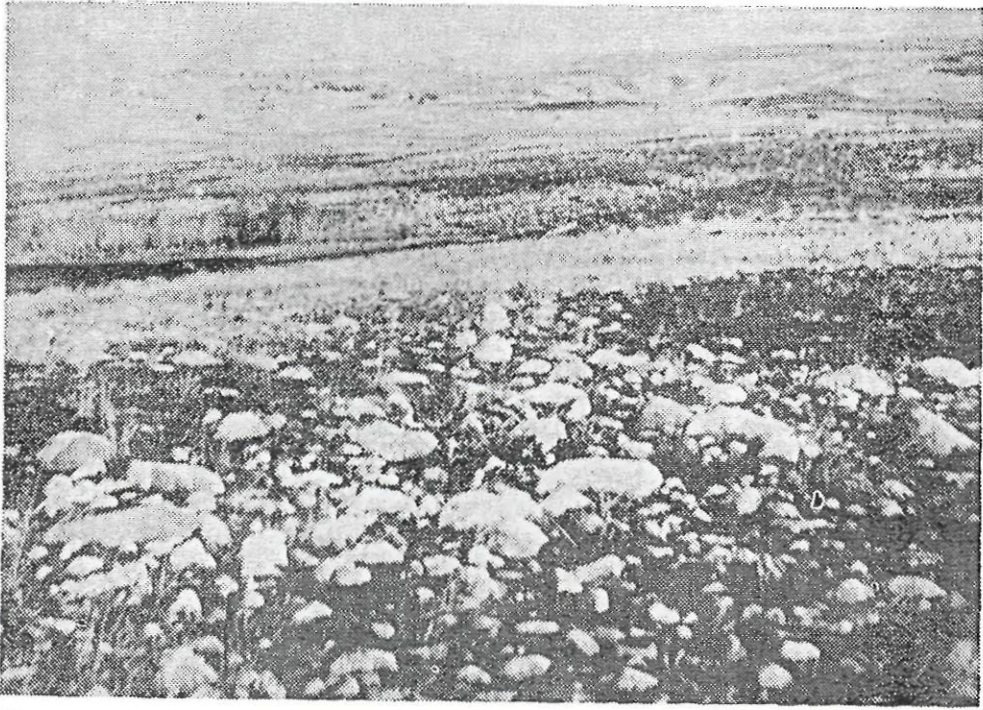


Figure 23. Stony untillable land is the only native range left to the sharp-tailed grouse.

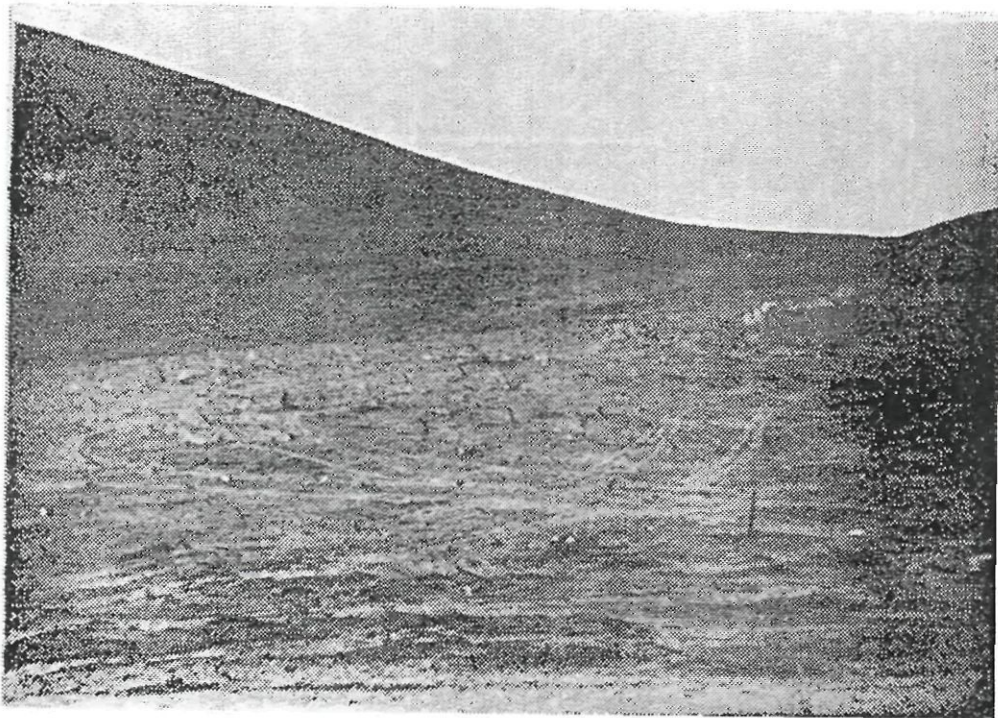


Figure 24. Burned-over range destroys sharp-tailed grouse habitat.

cultivation began approximately 100 years ago, when Utah first became settled by the white man, and has continued until the present. The high hay and grain prices which have prevailed during and since World War II have caused the farmers to increase the amount of land under cultivation. The improved financial conditions enjoyed by the farmers in recent years have enabled them to buy more and improved farm machinery with which they can profitably cultivate hillsides too steep to have been previously farmed. This new land placed under cultivation in sharp-tail ranges has further decreased the already limited habitat of the sharp-tails.

It is difficult to obtain accurate appraisals of the areas of native vegetation which recently have been placed under cultivation. Officials in the Production and Marketing Administration office in Tremonton, Utah, estimate that in recent years approximately 50,000 acres of native vegetation have been broken up and planted to grain in eastern Box Elder County. In the study area east of Paradise there was approximately 340 acres or 10 percent of the uncultivated grouse habitat plowed during the ten year period, 1937 to 1948. Each acre plowed was grouse habitat and critically needed to sustain the birds. These two examples indicate the continuing loss of suitable habitat to the sharp-tailed grouse in Utah.

Although cultivation may yield some benefits to the sharp-tails, particularly food, these do not nearly compensate for the loss of year-round habitat and for the dangers imposed upon the birds by modern agricultural methods. Grain fields yield an increased source of food in some seasons but this is only temporary. Much of the grain stubble is plowed in the fall which makes the waste grain available to the sharp-tails for only a relatively short period in the late summer and early fall. Stubble that is not plowed until spring is often covered by snow during the winter, so that the grain is generally unavailable to the birds during the season when it is most urgently needed. Alfalfa furnishes a food supply in late spring and early summer, but again this is for only a short period.

Cultivation has brought increased hazards for nesting sharp-tails. Grain stubble left until spring often attracts female sharp-tails to its cover to build their nests, which are then generally destroyed in spring plowing. Alfalfa also appeals to the sharp-tails for nesting cover. Unless the first mowing of the hay is delayed for some reason, the nests and sometimes hens and young chicks in alfalfa are destroyed in the mowing. The presence of cheat grass (*Bromus tectorum*) in alfalfa causes farmers to mow the alfalfa earlier than normal, thus destroying more nests. Pow-

er mowers are also more destructive because the operator has less time to avoid a nest or a brood.

Grazing.

Overgrazing apparently has been an important factor in causing the decline in numbers of sharp-tailed grouse in Utah, and in preventing their increase even while protected from hunters. Spring and fall habitat is generally at a premium in the parts of Utah still inhabited by the sharp-tails. This critical spring and fall range of the grouse which occurs on the foothills and bench-lands coincides with the critically short and badly abused spring and fall livestock range. Pastures which are used by farmers or ranchers year-round to maintain livestock on the ranch or farm also frequently occur in this grouse habitat. These range lands are, almost without exception, heavily over-grazed, or otherwise improperly grazed.

It is generally accepted by range specialists and plant ecologists that over-grazing or other improper grazing brings about a retrogressive plant succession leading away from the climax plant cover (Stoddart and Smith, 1943:244; Weaver and Clements, 1938:469-472). On the sharp-tail range it is evident that over-grazing has been a major factor in causing the reduction in density of the perennial grasses and berry producing shrubs, and the invasion or increase of less desirable annual and perennial weeds, grasses, and sagebrush. Although scattered clumps of sagebrush provide shade, shelter, and some food for sharp-tails and are evidently desirable in sharp-tail habitat, large areas of dense sagebrush are not used by these birds. Thus, it is found that the areas of sharp-tail habitat escaping cultivation have been so misused that the climax vegetative cover apparently desired and needed by the sharp-tails has largely disappeared and has been replaced by inferior cover.

The unfavorable changes in the vegetation which have resulted from increased farming and improper grazing becomes critical during the winter and nesting seasons. During the winter the annual grass and weed vegetation is dead and lies close to the surface of the ground, especially after grazing and trampling by livestock, and after heavy rains or snows. Such cover does not furnish protection for the grouse against inclement weather or predators, and what food it furnishes is too frequently made unavailable by snow.

The vegetative cover which now occurs on the sharp-tail range may not be as highly attractive as the climax vegetation was to the grouse for nesting cover. A considerable number of the sharp-tails nest in cultivated crops where their nests are of-

ten destroyed and some birds are killed. It is possible that the sharp-tails are more attracted to hay crops for nesting than they would be to the native bunch grasses. This has not been determined and probably will never be determined in Utah because of the lack of any sizeable area of sharp-tailed grouse range remaining in the climax bunch grass vegetation. However, it can be said with certainty that the present day destruction of sharp-tail nests is primarily caused by one or both of the agricultural practices, i.e., cultivation and improper grazing.

Proper grazing in contrast to over-grazing practices on the foothill and benchland ranges in Utah would benefit both the landowners and the sharp-tailed grouse. It has been shown that productivity of carefully managed ranges is much greater than that of improperly used ranges. Proper use of the range would also permit the vegetation to return nearer to the climax which provides favorable habitat for the sharp-tails.

Burning.

Burning is a practice that may vary in effect from definitely harmful to positively beneficial for the sharp-tails according to local conditions. It is listed here as a limiting factor because in the past it usually has been detrimental to the habitat of sharp-tailed grouse.

It has long been a common practice for landowners to occasionally burn range land, and, when properly used, burning may be a valuable tool in the management of range lands in Utah. The objective is to improve grazing by either removing dry, unpalatable, herbaceous material and making available the new growth of vegetation, or by removing or reducing undesirable shrubs to allow increased growth of desirable herbaceous plants through decreased competition. Other common burning practices are the burning of grain stubble and the burning of vegetation on areas prior to placing them under cultivation.

Burning may promote the growth of grasses and weeds, but it also reduces certain shrubs which furnish winter food and cover for the sharp-tails. Where lack of shrubs furnishing this winter food and cover, such as chokecherry and serviceberry, is a limiting factor in the sharp-tail habitat, burning of the range which sets back these plants may be decidedly harmful to the sharp-tails where lack of shrubs furnishing this winter food and cover, such as chokecherry and serviceberry, is a limiting factor in the sharp-tail habitat, burning of the range which sets back these plants may be decidedly harmful to the sharp-tails. Fire is believed to have caused the elimination in certain areas of northern Utah of most of the wild fruits and buds so essential to the grouse

in severe winter weather.

Where sagebrush had invaded and become dominant to the exclusion of most grasses and other desirable plants, proper controlled burning to remove some of the sagebrush and allow grasses and herbaceous plants to increase, improves the range for grazing as well as improves the habitat for sharp-tails. This apparently has occurred by accidental burning of sagebrush near the sharp-tailed grouse sanctuary east of Paradise, Utah.

Another effect of burning may be accelerated erosion which also results in changes in the vegetation away from the more desirable climax species.

Because of carelessness or improper precautions, fires intended to burn grain stubble or to clear land prior to cultivation often escape and burn range lands with the effects discussed above. Burning of grain stubble results in ill effects similar to those of plowing; in the fall it destroys winter food and cover, and in late spring it destroys nests located there. The observance of proper practices and precautions would often minimize the damage done by burning to the habitat of the sharp-tailed grouse.

Hunting.

One of the factors that undoubtedly caused a reduction in the sharp-tailed grouse population in the early days after settlement of Utah was the heavy hunting to which these birds were subjected. They were bagged by the hundreds or even wagon-loads. However, legalized hunting now is not a factor in causing the sharp-tail population to remain at a low level for there has been no open season on these birds since 1925. Farmers that live in the sharp-tail range state that some sharp-tails are poached or accidentally killed by pheasant and rabbit hunters. Losses by illegal hunting may be serious locally, but would not be of great importance in the over-all picture if other conditions were generally favorable for the sharp-tails. The fact that these birds have continued to decline in numbers with 25 years of protection from hunting indicates that other factors are more important in limiting the numbers of the sharp-tailed grouse in Utah.

Predation.

Wildlife technicians generally consider that predation is rarely an important limiting factor for game birds except where populations are excessive for the existing habitat or are otherwise insecure. Most of the available information indicates predators take relatively few sharp-tails in Utah. However, rather intensive predation studies made by Deming (1938:31) in

southwestern Cache Valley during late fall, winter, and spring of 1937-38 resulted in a surprisingly large number of dead sharp-tails being found that were apparently killed by predators. On a study area of approximately 640 acres which had an estimated population of 49 sharp-tails, the remains of 28 (57 percent) of these grouse were found. The killing or cleaning up of these birds was attributed as follows: 8 to coyotes, 6 to weasels, 1 to a bird of prey, and 13 unknown.

No other instances of sharp-tail deaths of this magnitude have been found, even on the same area in earlier years. It was subsequently found that telephone lines were strung across the center of the predation study area a short time before the study was made. Sharp-tailed grouse and other game birds are known to fly into telephone, high tension, or fence wires occasionally. This is especially true until the birds become aware that these obstructions exist. Twenty of 24 locations of sharp-tail remains were within 100 yards of the newly erected telephone line. This is only circumstantial evidence, but it indicates that most of the birds killed or cleaned up by the predators may have been killed or crippled by flying into the telephone wires. However, the study shows that mortality of sharp-tails at times may reach unsuspected proportions.

A list of predators or potential predators on sharp-tailed grouse or their nests that have been observed in sharp-tail habitat in southern Cache Valley includes:

- coyote (*Canis latrans*)
- dog (*Canis familiaris*)
- house cat (*Felis libyca domestica*)
- mountain weasel (*Mustela frenata nevadensis*)
- striped skunk (*Mephitis mephitis*)
- crow (*Corvus brachyrhynchos*)
- magpie (*Pica pica hudsonia*)
- California gull (*Larus californicus*)
- great-horned owl (*Bubo virginianus*)
- golden eagle (*Aquila chrysaetos canadensis*)
- hawks
 - sharp-shinned (*Accipiter striatus velox*)
 - Cooper's (*Accipiter cooperi*)
 - goshawk (*Astur atricapillus*)
 - Swainson's (*Buteo swainsoni*)
 - W. red-tailed (*Buteo borealis calurus*)
 - Ferruginous rough-legged (*Buteo regalis*)
 - marsh (*Circus hudsonius*)

Coyotes have been observed making both successful and unsuccessful attempts to catch sharp-tails on dancing grounds, and

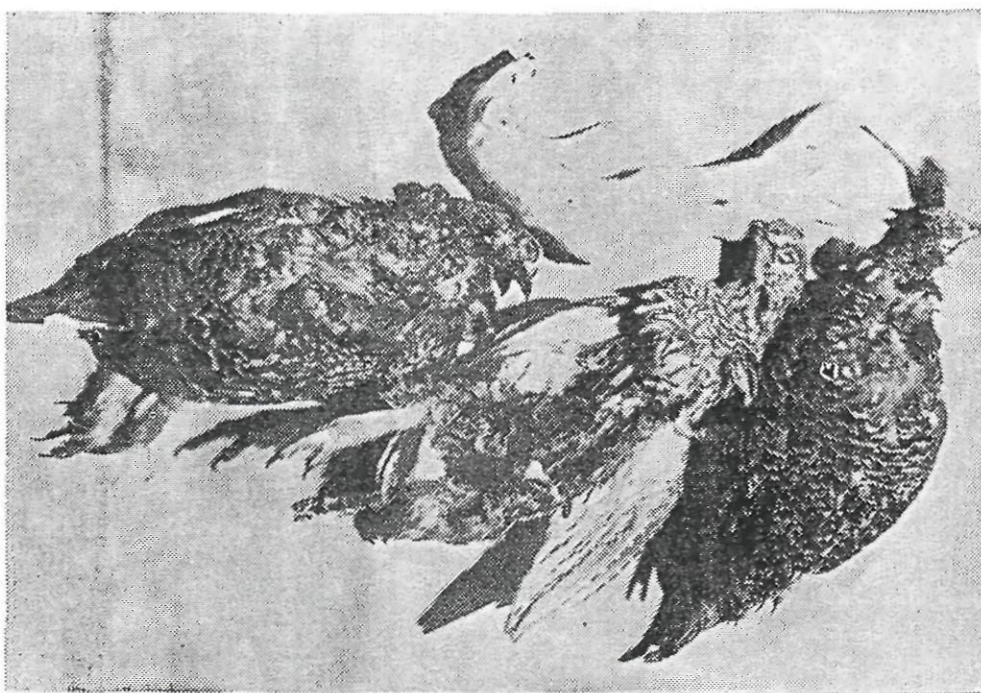


Figure 25. Typical evidence of weasel predation on sharp-tailed grouse. Note feathers pulled from neck region of bird where weasel attacked birds. Photo by O. Deming.

there is evidence that some of these birds are taken by weasels. Marshall and Jenson (1937:97) reported sharp-tails that were killed by skunks, but it is probable that these animals are more important as nest predators and rarely prey on healthy adults.

Farmers state that "bullet" hawks (Cooper's and sharp-shinned) are efficient hunters of the young grouse. Great-horned owls are noted bird predators, and the establishment of a pair of these owls in or near sharp-tail habitat may lead to losses in the grouse populations. Marsh hawks are generally beneficial but are known to be important predators on game bird chicks in some areas (Emlen, Glading, 1945:43) Bird hunting by the broad-winged hawks generally is limited to rare individuals that develop this habit.

The presence of the California gull in the above list of possible predators perhaps calls for explanation. It is included here as a possible or potential predator because of its known propensity for preying on ducklings, and is reported by Rasmussen and McKean (McAtee, 1945:247) to devour pheasant chicks in Utah. Flocks of these birds are frequently observed in sharp-tail habitat in northern Utah feeding on insects in alfalfa fields. These fields are frequented by the grouse for feed-

ing and nesting, so that sharp-tail chicks or eggs may occasionally furnish a meal for the gulls.

Weather.

Sharp-tails apparently suffer but little from inclement weather. Some young chicks may succumb to chilling or wetting by heavy, early-summer rain-storms, but there is no evidence to show that this constitutes a serious loss. The rolling or sloping uplands frequented by these birds are seldom subject to floods and nests or chicks lost to this factor ordinarily would be few.

As long as the sharp-tails are able to obtain sufficient nourishment, they appear able to withstand extreme cold. Their habit of tunneling into soft snow to roost or rest during cold weather enables them to withstand the coldest temperatures that occur on their range in Utah. Mid-day heat during the summer causes these birds some distress, which they avoid by seeking shade of shrubs and bushes.

Disease and parasites.

Older residents of the sharp-tail range state that during some years when these birds were plentiful they were occasionally found dead and have been reported to drop dead in flight, presumably killed by some disease. There are no records, however, of sharp-tails being found in recent years in Utah which were known to have been killed by diseases or parasites. In 1938, three sharp-tails, apparently killed by weasels, were examined and found to be free of disease and internal parasites, (Deming, 1938:53). A crippled sharp-tail that was captured was free from external parasites, as well as could be determined.

The presence of large flocks of domestic turkeys on the grouse range raises the possibility of diseases being transmitted from them to the sharp-tail population. To date no evidence is available to indicate that this takes place.

Accidents.

Sharp-tails are sometimes killed or injured by flying into objects, especially telephone, or electrical wires, and fences. The captured sharp-tail mentioned above had the ulna bone of the wing broken, although it could not be determined whether this was caused by a collision or gunshot. Joel Ricks, an early pioneer of Cache Valley is quoted (Lee, 1936:25) as stating: "In 1872-3, when the telegraph wire was put through Cache Valley, scores of Wild chickens (sharp-tails) were killed by flying into it. . . .". High tension and other electrical lines traverse much of the sharp-tail range in Cache Valley; previous mention has been made of recent evidence that numerous sharp-tails

may injure themselves on these wires.

Sharp-tails are occasionally killed by flying into moving vehicles, but evidently not as frequently as pheasants or sage grouse.

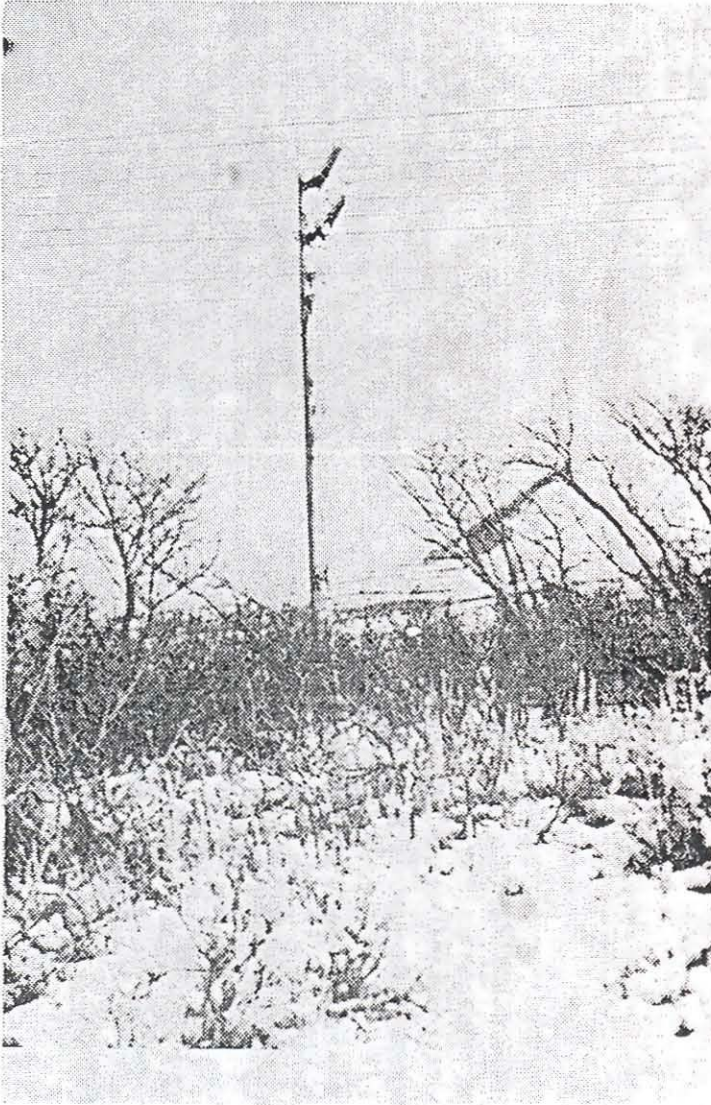


Figure 26. Telephone and electric power lines offer a serious hazard to flying sharp-tailed grouse.

Relation of sharp-tailed grouse to agriculture

The effects of principal agricultural practices upon the sharp-tail population have been discussed previously as limiting factors. These birds do not reciprocate in their actions upon agriculture; they are not generally considered to be harmful in any way in Utah. One does not hear complaints from farmers about crop depredations by this bird. Part of the diet of the sharp-tail consists of grasshoppers and other harmful insects, and weed seeds. The grain eaten by the birds in fall and winter is waste left by harvesting machines. This gleaning of waste grain may be considered a beneficial action since it helps to control volunteer grain.

The only known action by the sharp-tails which may be considered harmful to agriculture is the spring dancing of the birds in young grain. This is rather rare and occurs only where the birds persist in using traditional dancing grounds that have been placed under cultivation.

Farmers recalling the period when there were open seasons on the sharp-tails sometimes complained about the damage done by hunters pursuing these birds. Such damages were the usual ones committed by careless hunters on agricultural lands, and could be blamed only indirectly, if at all, to the sharp-tails.

Sentiment among the farmers is practically unanimous in favor of the sharp-tails. Most farmers enjoy seeing the birds on their property and favor protecting them in the hopes that the numbers of this interesting grouse may increase.

Relations to other upland game birds and domestic turkeys

Overlapping of ranges.

In Utah, the remaining sharp-tailed grouse habitat does not constitute especially desirable habitat for other upland game birds. However, there is some overlapping or interspersion of ranges, so that other upland game birds are found with varying frequency in areas inhabited by the sharp-tails.

The ring-necked pheasant (*Phasianus colchicus*) is frequently found on sharp-tail range in or adjacent to dry farm grain land, or where irrigated farm land is nearby. Farmers interviewed in southern Cache Valley during the summer of 1948 generally agreed that pheasants were increasing in the sharp-

tail habitat there. Cock pheasants were often heard crowing in patches of sagebrush in the sharp-tail range and in thickets of maple and chokecherry at higher elevations. Several broods of young pheasants were seen in sharp-tail habitat during the summer of 1948, one of which was at least a mile from dry farm land and several miles from irrigated land.

The sage grouse (*Centrocercus urophasianus*) is often found where the sharp-tail range contains sizeable areas of sagebrush. The two species of birds are probably found together most frequently in eastern Box Elder, eastern Weber, and southern Cache counties.

The gray ruffed grouse (*Bonasa umbellus incanus*) is occasionally found on sharp-tail range, usually in maple or chokecherry thickets in draws or along water-courses. The sharp-tails sometimes invade the ruffed grouse's habitat in winter when seeking buds for food.

The dusky blue grouse (*Dendragapus obscurus obscurus*) which occasionally moves down from higher elevations, is sometimes found in the habitat of the sharp-tail grouse in Utah.

Nests or broods of all of the above mentioned native grouse have been found in sharp-tail range.

In recent years the Hungarian partridge (*Perdix perdix perdix*) has been reported occasionally from various parts in northern Utah, some of them in sharp-tail habitat. These birds have apparently moved south from Idaho. Whether or not they will become established in the sharp-tail habitat remains to be seen.

Competition for food.

Apparently there is no serious competition at present for food among these species of upland game birds in Utah. Of the species in question, the pheasant and the sharp-tail have the most similar food habits. During the seasons of warm weather, food is generally plentiful for both species. The available food supply becomes more critical after much of the grain stubble has been plowed in the fall, and snow is on the ground. As the snow becomes deeper, the sharp-tails tend to move to higher elevations and feed on buds, while the pheasants move down to lower cultivated fields and marshes for winter food and cover. It seems that competition between these two species would become important only if the population of one or both species increased considerably above present numbers in the sharp-tail range.

Although some food items are common to the diets of the sharp-tail, other native grouse, and the Hungarian partridge,

there is no evidence to indicate that competition for food between the sharp-tailed grouse and the other species is an important factor in survival of either group of birds in Utah.

Interspecific tolerance.

Available information does not indicate the existence of any degree of intolerance between the sharp-tailed grouse and other upland game birds in Utah. Pheasants are sometimes seen around the sharp-tail dancing grounds, but they do not molest the dancers and their presence apparently does not bother the sharp-tails.

It is reported that sharp-tails are not tolerant of pheasants during the winter in Nebraska. Surprisingly, it is the sharp-tails which chase the larger pheasants and true prairie chicken from winter feeding stations. However, during the spring months the sharp-tails and pheasants are very tolerant of each other (McAtee, 1945:229).

Relation of domestic turkeys to sharp-tailed grouse.

Large flocks of domestic turkeys are commonly ranged during the summer and early fall on alfalfa stubble, grain stubble, or weed fields within, or adjacent to, sharp-tailed grouse habitat in Utah. The turkeys feed on green vegetation, waste grain, and grasshoppers, and thus convert waste crop materials and injurious insects into income for the farmer or turkey owner. However, turkey grazing is decidedly not beneficial to wildlife in general or to the sharp-tailed grouse habitat. A range considerably over-grazed and trampled by sheep has the appearance of having a good vegetative cover when compared to an area subjected to heavy use by turkeys. Over a period of time the turkeys may almost completely strip the vegetation from a field, leaving it barren and dusty, or with only leafless, coarse plant stems remaining.

Fortunately, for the sharp-tails, the fields ranged over by the turkeys are usually not the most desirable grouse habitat, but the presence of turkeys may necessitate a shift in the feeding grounds used by the grouse, since the turkeys rather thoroughly remove the food supply in localized areas. It has been observed that sharp-tails did not return to an area for approximately two months after it was grazed by a flock of turkeys.

MANAGEMENT AND PRESERVATION OF THE SHARP-TAILED GROUSE IN UTAH

Except for creation of an inviolate sanctuary in Cache County management of the sharp-tailed grouse in Utah to date has been limited to prohibition of hunting and to some winter feeding, partly of an experimental nature. Policies and procedures that have been followed are reviewed in the ensuing paragraphs, together with management recommendations. It is hoped that an active management program for the sharp-tails may be initiated in Utah in the near future, for it is evident that such a program is necessary to insure the existence of this rare, interesting game bird within the state.

Census methods.

Knowledge of total population numbers or of population trends is essential to the intelligent management of any species of wild-life. Attempts to determine the number of sharp-tails in Utah have been made only 3 times in the past 15 years. This should be done at least biennially and preferably annually to keep wild-life managers informed of the current status of the sharp-tail population, and of the success of, or necessity for, management practices.

Counts of sharp-tails using dancing grounds in the spring is a frequently used method of determining population trends of the species, and has been employed to a limited degree in Utah. This method necessitates locating all of the dancing grounds in use within a unit of sharp-tail habitat and making counts of the birds on the grounds at intervals throughout the courtship season. The average number of grouse per dancing ground at the peak of the season together with the number of dancing grounds being used gives a population index figure, which in turn indicates the population trend when compared to results obtained from similar surveys in previous years.

A small portable blind has proved useful in making observations of this type. Counting directly from an automobile driven on or near the dancing ground may prove practicable where the terrain permits.

In late summer (August), a high percentage of the sharp-tails in an area can be counted by traversing the range in mid-day and flushing birds from the preferred loafing spots in shade-producing cover. In late fall and early winter, counts of the number of birds in the large flocks occurring then are very useful in making population estimates. To successfully use either

of these methods, it is necessary to have intimate knowledge of sharp-tail habits and of the terrain to be covered. A well-trained bird dog is very useful in locating and flushing the birds, and considerably more area per day can be covered on horseback where fences are not numerous.

Control of hunting.

Restrictions on hunting are usually the first measures applied in attempts to preserve game species that are seriously decreasing in numbers. No open hunting season on sharp-tailed grouse in Utah has been declared since 1925, and this policy has probably been instrumental in preventing the sharp-tail from becoming extinct here. However, in spite of this protection from hunting, these birds have continued to decrease or have barely maintained their numbers in some areas.

The closed hunting season should be continued indefinitely for the sharp-tailed grouse in Utah. These birds may never again become numerous enough to permit them to be hunted. All possible precautions should be taken to prevent them from being killed by illegal hunting. Because of the precarious position of the sharp-tailed grouse, it is suggested that pheasant and rabbit hunting be restricted in the areas of greatest abundance of the sharp-tail. The loss of these few small areas for rabbit or pheasant hunting would be infinitesimal and the benefit to the sharp-tails by reducing possibilities of illegal shooting would likely be great.

Refuges and sanctuaries.

Refuges to protect the sharp-tailed grouse in Utah were first established during the late 1930's. One refuge of about 5,500 acres was established in 1938 south of Wellsville in southwestern Cache Valley, and another of about 4,300 acres was established northeast of Paradise in southeastern Cache Valley at approximately the same time. Both refuges were on private land and were the result of cooperative agreements between the landowners and the Utah Fish and Game Department. The refuge agreements were to be in force for five years, and, upon expiration, could be renewed by mutual consent of the parties concerned.

At present (1950), the Paradise refuge agreement is still in force, but the Wellsville refuge was allowed to lapse in 1943 at the end of the first 5-year period. Landowners interviewed in the Wellsville area during the summer of 1948 favored continued protection for the sharp-tails through the re-establishment of the Wellsville Refuge.

Safeguarding a "seed stock" of the original sharp-tailed grouse should be the first step in management of this bird. Should the

need arise for seed stock of this fastly vanishing game bird it would be desirable to have stock acclimated to this part of the country. In addition, the perpetuation of this formerly abundant native species will furnish pleasure and esthetic value to people who enjoy seeing this rare bird in its native habitat.

At least one "perpetuation refuge" is urgently needed to save this bird from extinction, the fate of its cousin the heath hen. This one piece of land should be procured in the center of the remaining sharp-tailed habitat in Utah. In the interests of the bird's preservation costs of this one tract of land should not be the prime consideration. Time is an essential factor and the sooner the sanctuary is established the better the chance will be of perpetuating this remnant of the states native avian fauna.

In addition, other state-owned sharp-tailed grouse refuge and sanctuary areas should be established where these birds are still found. Valuable agricultural land need not be taken out of production for this purpose; submarginal cultivated land or poor grazing land should be bought and managed to encourage the growth of the native vegetation. Public ownership and management of some key areas of habitat for the sharp-tail appear highly essential for the preservation of this species in Utah. As long as these areas remain in private ownership they may be plowed, overgrazed, burned, or handled in any other way that the owner may choose, so that the habitat is ruined or seriously reduced in value for the sharp-tails. This is not a condemnation of the landowners; their actions are governed by what they believe to be economically best for themselves.

Even with present inflated land prices, the cost of these refuges cannot be regarded as prohibitive to a public agency since they are considered essential in the preservation of the sharp-tailed grouse. Undoubtedly such key areas might well be purchased through the Federal Aid in Wildlife Restoration program in which the state furnishes 25 percent of the expense of approved projects.

Where sharp-tail populations occur and it is not feasible for the state to purchase a refuge, a sharp-tailed grouse sanctuary should be established by mutual agreement between the Utah Fish and Game Department and the landowners, unless the value of such an area for hunting other game considerably outweighs its value as a sharp-tailed grouse sanctuary. After a short trial period, sanctuary agreements should be written for an indefinite period or until one of the cooperating parties requests that the agreement be terminated.

Cover and food propagation.

State-owned refuges could be managed to produce vegetation that would provide the necessary cover and food required by the sharp-tails. Where desirable, particularly on the key refuge areas, such plants as chokecherry, serviceberry, and other cover and food-providing shrubs that are lacking or not plentiful should be planted. Where deer or elk winter on sharp-tail range, their browsing on these shrubs may make it necessary to fence some areas to exclude these animals until the shrubs are able to make vigorous growth and spread.

Regulation of grazing.

Excessive livestock grazing is apparently the most important factor limiting the numbers of sharp-tailed grouse on areas not under cultivation, and little can be done about the regulation of grazing on private lands. Public education, particularly of livestock and range land owners, in the practices and merits of proper range management is evidently the most likely solution to this problem on private lands. Advantage should be taken by private and public agencies of every opportunity to encourage the adoption of good range management practices in order to speed up the rehabilitation of run-down ranges in Utah.

Livestock grazing should not be permitted on sharp-tail refuges acquired by the state until the vegetation recovers to the point which provides the best possible food and cover for the sharp-tails, probably the climax or near-climax condition. Light grazing might possibly be permitted then to get dual use and economic return from the range, if it could be rigidly controlled to prevent damage to the habitat.

Control of fires.

Burning of range land should be discouraged except when it is plainly necessary or highly desirable, and should not be done during or shortly after the nesting season. It should be attempted only when conditions are such that the desired result will be obtained, and all necessary precautions should be taken to prevent fires from escaping from intended boundaries and causing unnecessary destruction. Burning of grain stubble is least harmful if done early in the spring, before the nesting season, if conditions permit burning then.

Controlled burning may prove to be a useful management tool for opening dense, extensive stands of sagebrush, which are not readily used by sharp-tails. In some areas such burning has

resulted in very good sharp-tail habitat of grassy cover with scattered clumps of sagebrush.

Winter feeding.

Winter feeding of sharp-tails has been practiced to some extent in Utah. Sharp-tails have used winter feeding stations established for pheasants in Weber County. One-fourth to one-acre plots of wheat were fenced and left standing in southern Cache Valley as food patches for the sharp-tails during the winters of 1938-39 and 1939-40. These were generally unsuccessful. Wind, rain, and snow soon flattened down the wheat so that it was covered by snow when other food was scarce. When this wheat was available, plenty of waste grain and other foods were also available. The food patches were used very little by sharp-tails; rabbits apparently were the chief beneficiaries.

Experiments with supplemental artificial winter feeding of wild game have generally shown that it is expensive, sometimes actually detrimental, and is a poor substitute for natural feeding. Efforts should be concentrated on land management that will grow plants affording the sharp-tails an adequate year-round supply of natural foods, with artificial winter feeding as a last resort only when extreme conditions make it necessary.

Farming practices.

Whenever possible, farmers should be encouraged to adopt farming practices that are least detrimental to the sharp-tailed grouse, provided that these practices do not cause the farmer an appreciable economic loss or unnecessary inconvenience. For the sharp-tail's benefit, grain stubble plowing is best done in the early spring, after it has served as a winter food supply and before the hens nest in it. However, spring weather conditions or other factors may not permit working of the fields this early. Fall plowing of stubble is recommended over plowing during the nesting season, which destroys a high percentage of nests. Installations of flushing bars on mowing machines should be encouraged; these appliances flush the nesting hens and save many of them from destruction, even though it may not be practicable to attempt to save their nests in hay and grain crops.

Control of enemies.

It is doubtful that protection from enemies other than that normally being carried on by public agencies is necessary or desirable for the sharp-tails in most areas. However, pred-

ators and rodents should be controlled where they are found to be causing excessive damage to the sharp-tail population or to the habitat. To be effective and not unduly expensive, such control should be intensive, local, and selective as to species or individuals that are destructive, and should be discontinued as soon as enemy populations are reduced to the level where they are no longer an important limiting factor in the environment of the sharp-tail.

Re-stocking.

Existing sharp-tailed grouse habitat in Utah is evidently stocked to its carrying capacity, so that re-stocking is neither necessary nor desirable. If, however, future proper range management or re-seeding of sub-marginal agricultural lands to grasses should create sizeable areas of good sharp-tail habitat from which the birds have been extirpated these areas should be restocked with sharp-tailed grouse. To carry on a restocking program, it would be necessary to develop a source of birds to be released. Should management practices on state-owned sharp-tail refuges prove successful, then any surplus sharp-tails, or a portion of the increase, could be trapped and released where it is desired to give the birds a new start.

The Michigan Department of Conservation has successfully transplanted sharp-tailed grouse to accelerate spread of this species throughout Michigan (Douglas, 1943: 8-9). If the remaining sharp-tails in Utah can be saved and increased by better management practices, perhaps it will be possible some day to re-establish them on much of their former range throughout the state.

Continued Research.

Next in importance to the acquisition of a perpetuation refuge and other management sanctuaries is the desirability of continuing investigations of the life history, and habitat requirements of this bird. Considerable basic information has been gathered, but much remains to be learned. Knowledge of sex ratios, movements, population numbers, and incidental data that could be obtained by a successful live-trapping and banding program would be of value in understanding and managing the sharp-tails. An intensive study of various factors in the reproduction of these birds may show that protecting and preserving existing dancing grounds and providing good nesting cover within a limited radius of these spots is necessary to the continued existence and welfare of the sharp-tails. To obtain maximum benefits from management, a long-range program of investigations should be diligently pursued.

SUMMARY

1. The Columbian sharp-tailed grouse, once abundant in Utah, is now comparatively rare.
2. The present report is the culmination of studies which have been made at irregular intervals throughout the past 15 years by students and biologists of the Utah Cooperative Wildlife Research Unit and the Utah State Department of Fish and Game.
3. The sharp-tails were originally abundant on grassy plains, benches, and foothills in northern and central Utah, but are now restricted to a few localized areas in north central Utah. Population estimates made in 1936 and 1948 indicate approximately 1,500 sharp-tails in Utah, with the greatest concentrations in southern Cache Valley and northern Ogden Valley.
4. Nests and broods of the sharp-tails suffer heavy mortality. Approximately two-thirds of the sharp-tail nests are destroyed by alfalfa mowing or stubble plowing, and approximately 50 percent of the juvenile birds are killed before reaching maturity.
5. Selection of food is greatly influenced by availability, and preferred winter food is often scarce. Wheat, and seeds and leaves of native plants are important year-round foods, while insects are important summer food of both adult and juvenile sharp-tails. Buds of trees and shrubs are main items of food when the snow is deep.
6. The destruction of sharp-tail habitat by cultivation, improper grazing and burning has undoubtedly been the principal factor causing the decrease in the sharp-tail population in Utah.
7. Protection of the bird from hunting, since 1925, has been the principal method followed to date in attempting to preserve the sharp-tail in Utah.
8. Foremost in the needs of the bird in its fight for existence is the establishment of a "perpetuation" refuge where the bird can be rigidly protected from all interference. It is recommended also that a system of state-owned areas be established, where full or partial control of cultivation, livestock grazing, and burning can be coupled with the planting of food and cover plants to improve the habitat to meet the bird's exacting requirements.

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